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TERRITORIAL BEHAVIOR--A MEANS OF POPULATION
REGULATION IN MULTIPLE HABITATS^{1,2}

William E. Cooper, Jr.

*Department of Biology
Auburn University at Montgomery
Montgomery, AL 36117*

Abstract. The effects of territorial behavior on regulation of numbers are modeled for a population breeding in multiple habitats and tending to grow or decrease exponentially within each habitat. Associated with each habitat is a distinct intrinsic rate of increase. Since territorial behavior limits the number of individuals which may breed in each habitat, the number of individuals in a given habitat reaches a maximum at some size of overall population and remains constant above that level. According to the model presented, the overall population growth may be slowed by territorial behavior or even brought to an equilibrial value dependent on the intrinsic rates of increase and maximal numbers in the available habitats.

Although much discussion has been devoted to the proposition that animal populations may regulate their numbers by territorial behavior, there have been very few attempts to place the relationship between population density and territoriality into an analytical framework. Perhaps the great controversy surrounding the evolutionary origin of territoriality as a mechanism for regulating density has tended to obscure the very characteristics of the mechanism's operation.

Studies of density regulation by territorial behavior have focused largely on birds although the regulation may apply to other organisms such as iguanid lizards. Two significant papers appeared in 1969. First, Jerram Brown (1969) argued that the effects of territorial behavior depend on certain critical density levels. At level 1, density is low enough that no individuals are excluded from the most preferred habitat by territorial behavior of conspecifics. At density level 2, some individuals are displaced from the preferred habitat but are able to breed in somewhat less productive habitats. At density level 3, all habitats in which successful breeding could take place are filled to capacity by territory holders and a group of surplus potential breeders called floaters exist without territories. Fretwell and Lucas (1969) presented a model of limitation of bird numbers based on habitat selection. At low densities

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in this model, all birds select territories in the habitat of highest suitability, which is the habitat in which reproductive success is greatest. However, occupation of territories decreases the suitability of the best habitat until at some density, the occupied habitat becomes less suitable for new settlers than some other habitat, which newcomers then proceed to occupy as density increases without as much interference from territory holders. This process may continue to include several less favorable habitats. Savidge (1974) has developed a discrete model for management of territorial bird populations which behaviorally regulate population growth.

The current paper presents a simple continuous model of the effects of territorial behavior on population growth. Growth in natural populations is subject to many influences, including vagaries of weather, food density, predation, and interspecific competition, to name a few. All these variables must be taken into account in empirical field studies, but are for analytical purposes considered in the model to assume constant values. It is assumed that at some population density, N^* , no more territories are available to accommodate potentially breeding females in the most suitable habitat. At higher densities, the excess females overflow into the next most suitable habitat.

Conditions of this model are by no means satisfied by animals in general. They are most likely to be found among species occupying multi-purpose feeding-breeding territories. Species maintaining feeding territories or breeding territories such as leks would often be subject to severe constraints making such population regulation highly dubious. Among vertebrates the most likely groups to be regulated in the manner described are redwing blackbirds, ecologically similar avian species, and numerous iguanid and agamid lizards.

First consider the situation with two habitats, but the model will later be extended to any desired number. Population growth is considered to be exponential, with numbers increasing without limit in the absence of territorial exclusion. For regulation of numbers to be effective, territoriality must at some density bring a halt to the unlimited growth. No implication of group selection is inherent in this process.

Let N be the number of females in the population, r_1 the intrinsic rate of increase in the more suitable habitat, and r_2 the intrinsic rate of increase in the less suitable habitat. Note that throughout this paper, r represents a constant, a rate of increase independent of population fluctuations. Fretwell and Lucas (1969) and MacArthur (1972) note that increasing densities result in lower values of r in the various habitats available to a population. Analytical solutions to the equations presented below can only be obtained for constant values of r . However, the theoretical effect of density on r would intensify the limitation of population growth by territoriality.

At low densities, all females occupy the most suitable habitat. In that habitat, exponential growth proceeds according to the equation

$$\frac{dN}{dt} = r_1 N$$

territoriality-limited exponential growth

$$\frac{dN}{dt} = \begin{cases} r_1 N, & 0 < N \leq N^* \\ r_1 N^* + r_2 (N - N^*), & N^* \leq N \end{cases}$$

**N^* - maximal number of territory holders
in the 1st habitat**

$$N_t = \begin{cases} N_0 e^{r_1 t}, & 0 < N \leq N^* \\ \frac{[r_2 N_0 + (r_1 - r_2) N^*] e^{r_2 t} - (r_1 - r_2) N^*}{r_2}, & N^* \leq N \end{cases}$$

continuation of exponential growth

$$r_1 N = r_1 N^* + r_2 (N - N^*)$$

$$r_1 (N - N^*) = r_2 (N - N^*)$$

$$r_1 = r_2$$

equilibrium induced by territoriality

$$\frac{dN}{dt} = r_2 N + (r_1 - r_2) N^* = 0$$

$$r_2 (N - N^*) = -r_1 N^*$$

$$r_2 = -\left(\frac{N^*}{N - N^*}\right) r_1$$

Figure 1. Summary of equations for population growth and equilibrium when an exponentially growing population in two habitats is regulated by territorial behavior.

as long as the number of animals remains less than or equal to N^* . Thus at low densities, the size of the population is given by

$$N_t = N_0 e^{r_1 t}$$

Territorial Behavior

where N_0 is the number present initially and N_t is the number after some period of time, t , has elapsed.

When the population reaches N^* , any new additions to the population are excluded from the more suitable habitat by territorial behavior of the residents. The population segment which comes to occupy the less suitable habitat is characterized by some intrinsic rate of increase which is presumably less than that in the more suitable habitat. In the second habitat, the number of individuals in $N - N^*$. Therefore,

$$\frac{d(N-N^*)}{dt} = r_2(N-N^*).$$

Considering the population of both habitats,

$$\frac{dN}{dt} = r_1 N^* + r_2(N-N^*), \quad N^* \leq N.$$

Thus, we obtain the total population at any time by,

$$N_t = \frac{[r_2 N_0 + (r_1 - r_2)N^*] e^{r_2 t} - (r_1 - r_2)N^*}{r_2}, \quad N^* \leq N.$$

Note that N_0 must be greater than or equal to N^* . Otherwise different initial conditions must be applied in solving the differential equation.

Given this equation, we can examine the effects of territoriality on population growth. First, it is possible that territoriality might have no effect, i.e., population growth might continue at the same rate when both habitats are occupied as at lower densities when only the more suitable habitat is occupied. For this to happen, the differential equations would have to be equal in both cases:

$$\frac{dN}{dt} = r_1 N = r_1 N^* + r_2(N-N^*).$$

Solving for r_1 , we have

$$r_1(N-N^*) = r_2(N-N^*),$$

$$r_1 = r_2.$$

This indicates that if and only if the intrinsic rates of increase are equal in the two habitats will territorial exclusion have no effect on population growth. Unless the habitats are reproductively identical (in terms of r values), territorial behavior alters growth.

Although territoriality is thus seen to affect a population's growth rate, it is not yet clear whether territoriality can slow growth sufficiently to bring about either a decrease in numbers or an equilibrium number. To reach an equilibrium size, the population would have to have a growth rate of zero:

$$\frac{dN}{dt} = r_1 N^* + r_2 (N - N^*) = 0$$

$$r_2 (N - N^*) = -r_1 N^*,$$

$$r_2 = -r_1 \frac{N^*}{N - N^*}$$

This equation gives the intrinsic rate of increase in the less favorable habitat which brings the total population growth to a halt. In the second habitat there must be a negative growth rate to offset the increase in the other habitat. If r_1 is positive, the population increases without bound if r_2 is greater than or equal to zero. When r_2 is negative, the equilibrium population size varies with the magnitude of r_2 , with the low equilibrium sizes corresponding to high absolute values of r_2 . The size of the population at equilibrium, N_e , is obtained by solving the above equation for N instead of r_2 :

$$r_1 N^* + r_2 (N_e - N^*) = 0$$

$$r_2 N_e = (r_2 - r_1) N^*$$

$$N_e = \frac{(r_2 - r_1) N^*}{r_2}$$

From this equation it can be seen that when (negative) r_2 is infinitely large, the equilibrium population number is just N^* :

$$N_e = N^* \left(1 - \frac{r_1}{r_2} \right)$$

$$= N^* - \frac{r_1}{r_2} N^*, \quad r_2 \text{ infinite}$$

$$= N^*.$$

This case corresponds to instantaneous death of immigrants in the less favorable habitat. Small negative r_2 values produce larger equilibrium populations. Some of these effects are illustrated in Figure 2, which shows population growth for several values of r_2 for populations with identical r_1 , N_0 , and N^* values. For positive and zero r_2 values, the population increases infinitely, with large r_2 values producing rapid growth. Note that growth is linear to the right of the dotted vertical line when $r_2 = 0$. The dotted line indicates the time at which the less favorable habitat first receives occupants. The growth equation in this special case is:

$$\frac{dN}{dt} = r_1 N^*,$$

and the size of the population is

Territorial Behavior

$$N_t = r_1 N^* t + N^*$$

$$= N^*(r_1 t + 1).$$

Curves for the two lowest negative r_2 values rapidly approach equilibril population sizes, but the population for $r_2 = -.01$ continues to increase rapidly throughout the first 100 time intervals.

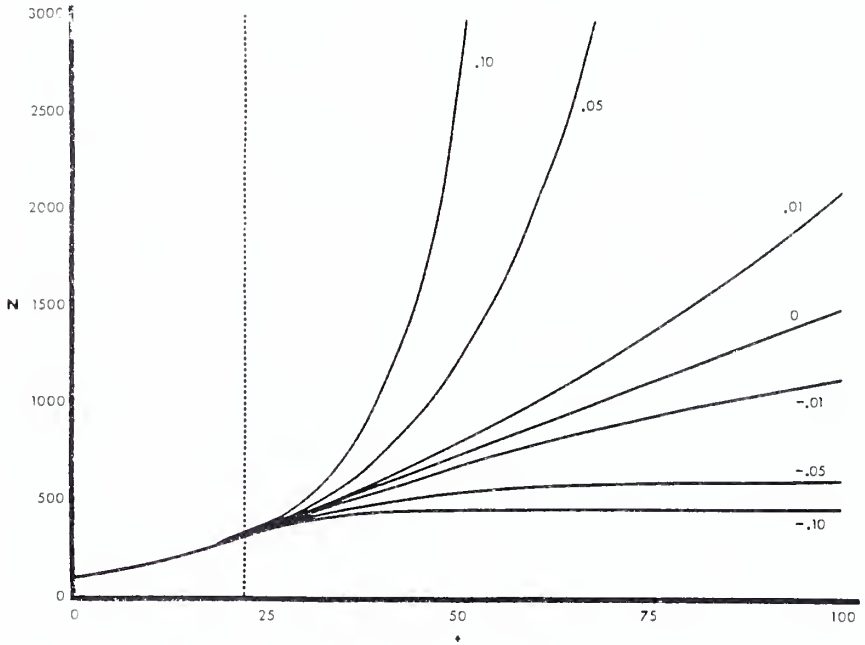


Figure 2. Population number is plotted against time. The various curves show growth at different values of r_2 . In each case, $N_0 = 100$, $N^* = 300$, and $r_1 = .05$. The dotted vertical line indicates that territoriality first forces individuals into the second habitat at $t = 22$.

Further insight may be gained by considering the relationship between population size and r_2 . Each curve in Figure 3 gives the population sizes at a particular time for the indicated range of r_2 values. Since the curves are truncated at $N = 3000$, curves for the longer elapsed times show the populations corresponding to high intrinsic rates of increase.

It may be of interest to determine the proportional effect of territoriality-limited population growth compared with unlimited exponential growth. Assume that the population would grow exponentially in the absence of territorial behavior and let $N = N^*$ at the outset, t_0 . The

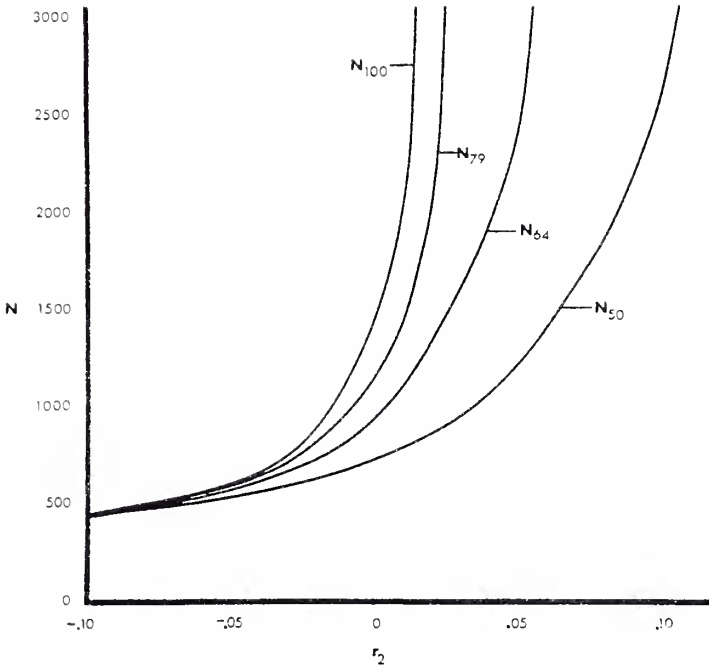


Figure 3. Population size is plotted against intrinsic rate of increase in the second habitat. Separate curves are shown for selected elapsed times (100, 79, 64, and 50 time intervals). $N_0 = 100$, $N^* = 300$, and $r_1 = .05$.

territorial decrement, D , is the difference between the N s obtained by the two forms of growth:

$$D = N^* e^{r_1 t} - \left[\frac{r_1 N^* e^{r_2 t} - (r_1 - r_2) N^*}{r_2} \right]$$

$$= \frac{r_2 N^* e^{r_1 t} - r_1 N^* e^{r_2 t} + (r_1 - r_2) N^*}{r_2}$$

$$= \frac{r_2 N^* (e^{r_1 t} - 1) - r_1 N^* (e^{r_2 t} - 1)}{r_2}.$$

The proportional decrease of the population due to territoriality, d , is the territorial decrement divided by the size of the population produced under exponential growth:

$$\begin{aligned} d &= \frac{D}{r_1 t N^* e^{r_1 t}} \\ &= 1 - \frac{r_1 N^* e^{r_2 t} - (r_1 - r_2) N^*}{r_2 N^* e^{r_1 t}}. \end{aligned}$$

D is discontinuous at $r_2 = 0$ and at equilibrium since t is infinite when

$$r_2 = \left[\frac{N^*}{N - N^*} \right] r_1.$$

Next consider the effects of territoriality on an exponentially growing population which has several habitats available to it. There are m habitats, each of which fills to a maximum number above which individuals are forced into the next less suitable habitat. Thus, all individuals occupy the most suitable habitat at low density. As densities increase, only the two most favorable habitats are occupied, then a third fills, and further habitats gain occupants in order of decreasing suitability. Let N_i^* be the maximum population size at which only the i most suitable habitats are inhabited and r_i be the intrinsic rate of increase of the portion of the population in the i^{th} habitat. Then

$$\frac{dN}{dt} = r_1 N^*_1 + r_2 (N^*_2 - N^*_1) + r_3 (N^*_3 - N^*_2 - N^*_1) + \dots + r_m (N - \sum_{i=1}^{m-1} N^*_i),$$

$$N \geq N^*_{m-1}.$$

For population growth beginning at or above N^*_{m-1} , this differential equation has the solution:

$$\begin{aligned} N_t &= \left[[(r_1 - r_2 - \dots - r_m) N^*_1 + (r_2 - r_3 - \dots - r_m) N^*_2 + \dots + \right. \\ &\quad \left. (r_{m-1} - r_m) N^*_{m-1} + r_m N_0] e^{r_m t} - (r_1 - r_2 - \dots - r_m) N^*_1 - \right. \\ &\quad \left. (r_2 - \dots - r_m) N^*_2 - \dots - (r_{m-1} - r_m) N^*_{m-1} \right] / r_m \end{aligned}$$

To trace a population's growth as it expands into several habitats, it is necessary to note the appropriate initial conditions for the most recently occupied habitat. Different conditions must be used with the different successively applied equations.

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NATURAL HISTORY OF THE BLACK BELT PRAIRIE¹

Thomas H. Wilson
Department of Biology
Judson College
Marion, AL 36756

Abstract. The natural history of the Black Belt prairie is discussed according to the geological evolution, physical geography, human invasion, natural vegetation, freshwater resources, and wildlife of the area. Observations of the prairie were made from automobile, airplane, and boat in an attempt to compare prairie of past and present. A brief literature review is presented along with accounts of current environmental alterations that are damaging the natural heritage of the Black Belt prairie at an alarming rate.

GEOLOGICAL EVOLUTION

A warm inland sea covered most of the Gulf Coastal plains during the Cretaceous period that occurred over 100 million years ago. During this time the Rocky Mountains were uplifting and the climax of giant land and marine reptiles was at hand. The Appalachian System with its Valley and Ridge had long since formed and was slowly being eroded to its present relief. Living in this warm sea were trillions upon trillions of microscopic, flagellated algae named coccolithophores. These phytoplankters had discs of calcium carbonate, known as coccoliths, on the surface of the cell. Through aeons, these coccoliths added to the marine calcareous sediments that formed into a muddy ooze and settled to the bottom of the seas. It was a warm water world with only about 18% of the earth's surface above water.

Coccolithic lime-rich parent material began to accumulate in great quantity in a unique region of upper coastal plain abutting the fall line or southern Appalachian boundary. This huge crescent-shaped deposit of calcareous sediments extends from northeastern Mississippi, southeastward through central Alabama, across the state to within 30 miles of the state's eastern border. In Alabama, this geologic formation is named the Selma chalk and it measures approximately 40 miles in its greatest width and 200 miles in length for a total of about 4,000 square miles. A similar blackland prairie exists in central Mississippi and its parent material is limestone mud of the Eocene epoch of 50 million years ago.

The rotten limestone of the Selma chalk is parent material to a calcimorphic surface layer of soil called rendzina, a soil order

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currently classified as mollisol. Rendzina soils are formed from grassland humus which imparts the dark color to the soil and, thus, the name Black Belt prairie. Blackland prairies of rendzina soils in the United States also occur in prairies of central and northeastern Texas and central Oklahoma (Strahler 1967).

The Black Belt peneplain lies in a tilting position that slopes to the southwest and, according to Harper (1943), coincides with the Selma chalk formation. Eutaw sand formations along the northern boundary and red clay along the southern boundary represent different surface soils that have the Selma chalk as parent material (Rankin 1974).

Giant white bluffs a few miles south of Selma on the Alabama River reach a height of nearly 100 feet and expose the Selma chalk in a brilliant display of geologic splendor (fig. 1). Smaller but of no less magnificence are the chalk bluffs on the Tombigbee River at Demopolis. Erosion from these great rivers displays strata of Eutaw sand, shale, red clay, soapstone, sandstone, and an array of marine fossil sediments that reflect on the coastal period of the area.

The rotten limestone of the Selma chalk weathers and erodes at a much faster rate than the associated deposits and, according to Dixon and Nash (1968), the central portion of the Black Belt with an elevation of 200 feet generally is about 100 feet lower than the adjacent Coastal Plain with an elevation of 200 to 300 feet above sea level.



Figure 1. Black Belt Prairie, Alabama River.

Natural History of the Black Belt Prairie

PHYSICAL GEOGRAPHY

Black Belt soils exhibit two extremes of pH, representing both the most alkaline and most highly acidic soils that occur in Alabama (Aiken 1961). These acid and alkaline soils are scattered throughout the prairie areas. Acid soils tend to occur in higher elevations and support the forested portion of the prairie and alkaline soils occur in the lower elevations and give rise to the open tall grass prairie. The Black Belt soils contain an abundance of montmorillonite clay, which shrinks and swells with changes in soil moisture. This gray prairie mud makes cultivation difficult due to the soil baking hard upon drying and then becoming highly adhesive and sticky when wet.

The soil province that makes up the Black Belt has a topography that is generally rolling with some steep slopes and nearly level areas. Surface rendzina soil colors include shades of brown, yellow, red, and gray to black (Hajek et al. 1975).

HUMAN INVASION OF THE BLACK BELT

Native Americans made little impact on the natural vegetation of the Black Belt prairie even though they routinely burned sections of forest to maintain forage areas for game. These first settlers of North America made their homes along riverine environs and, according to DeSoto (1540), cultivated fields of fruits and vegetables. Native Americans probably avoided the heavy clay soils of the prairie but used this area for hunting grounds.

Rankin (1974) presents a brief but informative literature review of the Black Belt prairie with attention given to early prairie descriptions. Accounts from the explorations of DeSoto (1540), DeLuna in 1560, Delgado (1686), Bartram (1771), Hawkins (1799), Stuart (1830), and Smith (1881), all referred to savannahs, plains, prairie, and treeless tracts in the Black Belt region. Township plots of the original survey contained sketches of prairie areas. The prairie was settled about 1817, but the planters avoided the black prairie land prior to 1830 because they had not learned to master the sticky soils (Stroud et al. 1930).

Early settlers and pioneers fought Native Americans and blazed a trail across central Alabama which was later to be known as Federal Road. The most important passage in early Alabama, Federal Road was the route by which wagonloads of settlers struggled to reach a crescent of fertile lands known as the Black Belt. The dark, chalky soil was rumored to yield cotton in such abundance as to make fortunes and establish dynasties (Hamilton 1977). The cotton boll weevil arrived in 1914 and later proved more deadly to the economics of the Black Belt than the Civil War, in which the Black Belt was called the "grainery of the Confederacy."

The first full treatment of prairie soils and vegetation was by Mohr (1901) and this list of natural vegetation mentioned cedar glades, post oak associations, canebrakes, and open prairies covered with tall grasses similar to that of the western prairies. Bartram (1777) described the lowland forests as "magnificent, grand high, and stately." Harper (1913)

wrote about the Black Belt and cited reports that the prairie contained many natural treeless areas.

Before the twentieth century, agricultural practices devastated the natural landscape and canebrakes were reduced to narrow strips covering stream banks. Mohr (1878) stated that native prairie vegetation could be found only on wastelands and along the borders of cultivated fields. But a prairie region in central Alabama did exist even though a few past references discussed the existence of an ecological prairie with uncertainty (Rostlund 1957).

Removal of soil material by erosion has tended to reduce the age of the soils as they now exist. Erosion was severe in many parts of the Black Belt when the prairie was used extensively for cotton from approximately 1850 to 1920 (Dixon and Nash 1968).

PRAIRIE NATURAL VEGETATION

Areas of low tree density occurred naturally on upland alkaline soils and composed the "true prairie." These areas were described as "prairie" by the early explorers. High tree densities were associated primarily with areas outside "prairie" and mostly on acid soils. In the field notes examined, *Quercus*, *Pinus*, *Carya*, *Liquidambar*, and *Fraxinus* were recorded as the dominant tree genera. *Quercus* species were by far the dominant fruit bearing trees and the kinds of trees recorded were those typical of the southeastern mixed forests (Rankin and Davis 1971).

Clark (1972) classified the Black Belt's vegetation as a prairie-forest mosaic with typical prairie and prairie-forest border taxa such as *Andropogon* spp., *Quercus* spp., *Juniperus*, *Liquidambar*, *Ulmus*, and *Carya* spp.

Imhof (1976) described the Black Belt as being the only extensive natural dry prairie east of the Mississippi River and south of the Ohio. The natural prairie of the Black Belt, according to Imhof, was the site of extensive cotton plantations. At present, Alabama grows barely five percent of the nation's cotton, and the Black Belt is largely pasture land, with the raising of livestock its major agricultural endeavor.

Vegetation is mostly grass with scattered osage-orange, *Maclura pomifera*, and pine woodlands. Küchler (1964) described the Black Belt's natural vegetation as a *Quercus-Liquidambar-Juniperus virginiana* grassland and forest combination and included the central prairie of Mississippi in this association. Strahler (1967) placed the Black Belt and Northeast Prairie of Mississippi in the tall grass prairie vegetation type along with the Grand Prairie of midwestern U.S. and the bluestem prairies of North Dakota and Minnesota southward to Oklahoma and the dense grasses of the Blackland Prairie of eastern Texas.

FRESHWATER RESOURCES

The Alabama, Warrior, Tombigbee, and Cahaba rivers plus an abundance of ground water supply the Black Belt with a wealth of freshwater, which contributes to the agricultural importance of the region.

Natural History of the Black Belt Prairie

Throughout the Selma chalk region, deep wells furnish nearly all of the water used for municipal and domestic purposes. At lower elevations, artesian wells have flowed constantly for decades but their volume has been reduced significantly in recent years due to irrigation and industrialization. Harper (1943) stated that the Black Belt received the least rainfall of any region in the state, for no apparent reason, except for the high rate of evaporation.

PRAIRIE OBSERVATIONS

Explorations of the Black Belt prairie by the author lead to few areas representative of the original prairie. County highway rights-of-way that aren't sprayed with herbicides occasionally appear as tall grass prairies. State Highway 183 between Marion and Uniontown in southwestern Perry County harbors grassland patches which abound with wildflowers and cedar glades. Soybean fields and pastures occupy most of the central prairie and the few patches of hardwoods are along creeks and rivers.

Aerial observations by the author revealed a great expanse of hardwood trees in the area immediately west and north of Demopolis that extended to the Mississippi state boundary. Several large swamps and Warrior River backwater areas create important waterfowl habitats and wildlife refuges. The region between Demopolis and Selma is composed mainly of farmland and pasture. Severely eroded areas around Uniontown expose the brilliant white Selma chalk parent material and serve as warnings of continued abuse of the land (fig. 2).



Figure 2. Black Belt Prairie, Uniontown.

The Cahaba River basin represents the last densely forested region of the prairie east of Demopolis. However, conversion of hardwood forests to soybean fields is rapidly denuding this serpentine shelter-belt into an ecological desert of fallow fields. Greater erosion can be expected as the flood plain forests are cleared and the raging Cahaba sweeps even more tons of topsoil toward the Alabama River and Mobile Bay.

The environs of Uniontown reflect original prairie conditions more than any other section in the Black Belt. Perry County Highway 1 south of Uniontown allows one to travel past exposed chalk formations and provides opportunities to see expansive fields of sorghum, sunflower, cotton, and corn. Along Perry County Highway 12 northeast out of Uniontown, tall grasses, *Rubeckia hirta*, *Aster* spp., and *Eupatorium rugosum* give an ancestral appearance to the landscape. *Juniperus virginiana*, *Celtis occidentalis*, and the naturally invading *Quercus* species dot the pastures. Clark (1972) cites *Maclura pomifera* as infrequent except in the Black Belt.

Abandoned cotton gins, warehouses, and homesteads are often covered with kudzu and the quest of more acres of soybeans is destroying the fragments of forests that still exist.

Exotic woody plants are invading the prairie and few native plants remain. Native hardwood trees particularly representative of the Black Belt prairie are *Quercus durandii* var. *austrina*, *Quercus falcata*, *Quercus falcata* var. *leucophylla*, *Quercus durandii*, *Quercus macrocarpa*, *Carya illinoensis*, *Carya myristicaeformis*, *Carya ovata*, *Carya glabra*, *Myrica cerifera*, *Zanthoxylum americanum*, *Nyssa aquatica*, and *Cornus drummondii* (Clark 1972).

Summer and fall blooming wildflowers commonly occurring along roadsides throughout the prairie are *Cassia fasciculata*, *Rubeckia hirta*, *Vernonia* spp., *Helenium flexuosum*, *Ipomoea purpurea*, *Solidago altissima*, *Oenothera biennis*, *Bignonia radicans*, *Helianthus* spp., *Eupatorium rugosum*, *Bidens* spp., *Polygonum lapathifolium*, *Aster* spp., and a variety of composites. The highway departments routinely spray herbicides along the rights-of-way and this unnecessary practice destroys much of the small prairie fragment that remains in the Black Belt.

The Black Belt prairie represents the northern range for central Alabama of *Quercus virginiana* and *Tillandsia usneoides* which has the common name of Spanish moss. Numerous rural roads, creeks, and riverine environs are heavily laden with this aerial epiphyte of the pineapple family. This Spanish moss belt reflects the subtropical climate of the area and adds to the "Southern image" of the region.

PRAIRIE WILDLIFE

Mount (1975) recognized the Black Belt as a distinct herpetofaunal region bordered to the south by the transitional zone of the red hills province and to the north by the fall line hills, which included an area often called the Upper Coastal Plain or Central Pine Belt. *Agkistrodon contortrix* and *Lampropeltis getulus holbrooki* are relatively common snakes

Natural History of the Black Belt Prairie

in the Black Belt and the salamander *Ambystoma texanum* seems fairly well adapted to the prairie. Numerous farm ponds and lakes often support an abundance, though not a great variety of water snakes, frogs, and turtles (Mount 1975).

Mount's (1975) list of native Black Belt reptile and amphibian species included 17 salamanders, 19 frogs, 14 turtles, 9 lizards, 20 snakes, 1 crocodilian, for a total of 90 native species.

With ever-expanding soybean cultivation, the prairie is fast becoming the dove capital of the state. The quail population is rebounding from two decades of continuous decline. Wild turkeys and exploding deer herds are common sights at the forest edge of the prairie.

Alabama has a great variety of bird habitats that range from bare ground, to prairie, and through successions to mountainous hardwood forests. Imhof (1975) found that the natural prairie of the Black Belt attracted at all seasons more open-country birds, and even some Western species, than anywhere else in Alabama. Imhof further stated that the southern edge of the Black Belt formed a natural bird boundary. This southern edge, with its rolling red clay hills, coincides with the southern edge of the Upper Coastal Plain and divides the Coastal Plain into two nearly equal parts. Imhof included the Black Belt in the Upper Coastal Plain avifauna and stated that much bird information is available from Montgomery.

Large mixed rookeries of *Guara alba* and *Bubuleus ibis* individuals are common to the cedar glades, flatland swamps and oxbows of the prairie. One of the most spectacular rookeries of this type is in the Uniontown-Faunsdale area.

In the summer of 1973, I made a personal observation of a road-runner, *Geococcyx californianus*, at the junction of Perry County Highways 45 and 6. Though unofficial, this is the only record of this species east of the Mississippi River for the entire nation.

CONCLUSIONS

Field trips on backroads through every county in the Black Belt failed to reveal any fragment of prairie supporting natural, native vegetation representative of that present before the invasion of Western man. The Black Belt prairie is basically composed of pastures and soybean fields with stretches of hardwoods along creeks, streams, and rivers.

No public land is preserved or restored to natural prairie and the rural roadsides are being poisoned with herbicides. Industrialization and population growth are encroaching on the few remaining natural areas.

The failure to include the Cahaba River in the Wild and Scenic River Act was another blow to the natural quality of the Black Belt prairie (Kaufmann and Wise 1978). The beauty of the Black Belt prairie is presently centered more around the open, flat topography and agriculture rather than natural heritage.

The limestone bluffs of the Alabama River south of Selma rank high on the list of scenic natural prairie areas. A small swamp near Marion on Perry County Highway 6 is very interesting and one of the few such areas as a result of land drainage programs. The most scenic prairie area occurs on the backroads between Uniontown and Marion and some of these roadsides bring back visions of Native Americans and grazing bison of bygone days.

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NOTES ON THE NESTING BIOLOGY OF THE MARBLED SALAMANDER,
AMBYSTOMA OPACUM, IN THE SOUTHERN PORTION
OF ITS RANGE¹

James W. Petranka and John G. Petranka
Department of Biological Sciences
University of Kentucky
Lexington, KY 40506

The marbled salamander, *Ambystoma opacum*, is a small, fossorial, woodland carnivore that ranges from southern New England to northern Florida and west to southern Illinois, eastern Oklahoma, and eastern Texas (Conant, 1975). The life history of this species is relatively well known; however, studies other than that of Stewart (1956) in North Carolina have centered on northern populations. Major life history accounts include those of Bishop (1941) in New York, Noble and Brady (1933) in the Washington, D.C. area, Graham (1971), Hassinger et al. (1970), and Anderson and Graham (1967) in New Jersey, Worthington (1968, 1969) in Maryland, and Smith (1961) in Illinois.

In 1977 we initiated a comparative life history study of *Ambystoma opacum* within the southern portion of its range (east-central Alabama). The results of this study concerning the larval ecology and evolutionary significance of nest placement will be published elsewhere. Data which pertains to other aspects of the nesting biology of the species are presented here.

STUDY AREA AND METHODS

Field research was restricted to an area about 1 mile south of the intersection of I-85 and U.S. Highway 80 in bottomlands that adjoin Choctawhatchee Creek, Macon County, Alabama.

Nesting biology data were gathered between 18 December and 1 January from a large, dry, temporary pool site along William Bartram Trail in Tuskegee National Forest (pool filling normally begins in late January or February). The site is located in mature southern hardwood forest. Soils in the area are mostly sandy loams; however, local clay deposits occur at the pool site. A 266 m² section of the pool, containing both the deepest and shallowest sections, was searched during two consecutive breeding seasons by carefully removing litter by hand from a small section at a time. In this manner, we were confident that all surface nests were uncovered.

Data were obtained on clutch sizes ($n = 44$ nests), egg (jelly coat) diameters (10 eggs/nest, $n = 24$ nests), snout-vent and total lengths of

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females (snout-vent measurements to posterior margin of vent, $n = 35$), behavior of females, and the microhabitat, placement, and dimensions of nests (maximum width \times maximum length, $n = 25$). Egg diameters, body lengths, and nest dimensions were measured to the nearest .5 mm, 1 mm, and .5 cm, respectively, using 1 mm graduated rulers. Adults were straightened and relaxed before measurements were made.

RESULTS

In Alabama, adults of *A. opacum* gather in the fall in forest floor depressions to engage in courtship, mating, and ovipositing (Mount, 1975). We initiated our study on 18 December at which time nests with fully developed embryos were discovered. During the ensuing two years, field observations were restricted to the winter, spring, and summer months, and fall breeding activities were not observed.

Forty-four nests were uncovered at the Bartram Trail site during the study period. Forty-two (96%) nests were located underneath leaf litter, the remainder were found under decaying logs. Nests were typically oblong to ovoid and completely filled with eggs (range = 9×3 – 10.5×7 cm, $\bar{x} = 8.2 \times 9.7$ cm). Construction occurred in bare mineral soil such that the uppermost eggs and attending female laid flush with the lowermost layer of leaf litter. Females actively constructed nests as evidenced by crumbled soil in the immediate vicinity, and the presence of exposed rootlets 1–2 cm above the soil surface.

Nest distribution patterns during both breeding seasons were similar. Females most often selected sites at intermediate elevations within the area of future pool formation (based on pool levels when at full capacity). A detailed treatment of nest placement and its evolutionary implications will be presented in a later paper, and is not present in detail here.

Females were often curled on the tops of clutches with their bodies partially submerged in eggs. They rarely attempted to escape, but, instead, remained motionless on the nests. In many cases females displayed a characteristic defense posture with the head bent strongly down, the legs straightened, the body lifted off the substratum, and the tail either curled forward or extended upward in a slightly curved fashion. If not initially present when uncovered, a defense posture could be elicited by gently prodding the animal with a blunt object. In addition, the production of copious amounts of milky secretions along the dorsal and dorsolateral surfaces of the tail could be induced by prodding these areas. The defense posture and behavior was similar to that reported by Brodie (1977) for this species except that tail lashing was never observed.

Females were present on 85% of the nests. Unattended nests contained significantly smaller clutches than attended ones (unattended: $\bar{x} = 75$, $n = 7$; attended: $\bar{x} = 98$, $n = 37$; Mann Whitney U-test, $U_s = 200$, $p = .012$). Mean egg diameters in unattended nests were smaller than those in attended nests, but the means were not significantly different (unattended: $\bar{x} = 6.0$ mm, $n = 5$; attended: $\bar{x} = 6.4$ mm, $n = 19$; Mann-Whitney U-test, $U_s = 70.5$, $p = .12$). Overall, clutch sizes ranged from

48-200 and averaged 95 ± 29 .¹ It should be emphasized that clutch sizes reflect survivorship to the sample period, and are presumably lower than the average clutch sizes that were initially laid.

Brooding females averaged 62.7 ± 3.5 mm snout-vent length and 108.7 ± 7.1 mm total length. There was no significant correlation between the body lengths and clutch sizes of brooding females ($F = 2.28$, $p = .14$).

Neither juvenile nor adult male *A. opacum* were uncovered at the study site; however, other amphibians were. These included several species of frogs (*Rana clamitans*, *R. pipiens*, *R. catesbeiana*, *Hyla versicolor*, and *H. cinerea*) and the mole salamander, *Ambystoma talpoideum*. Five male *A. talpoideum* with swollen vents were uncovered between mid-December and mid-January, but females were never encountered.

DISCUSSION

The nesting biology data for our study population generally agrees with that for northern populations. The active construction of nests and brooding of eggs appears to be characteristic of the species throughout its range. Average clutch sizes reported for northern populations vary from 87 (Green, 1956) to 150 eggs (Noble and Brady, 1933). King and Graham (1971) both reported about 10% mortality of eggs during the embryonic period in the field. If we apply these data to our population, the initial average clutch size of our study population would be about 105. Mean jelly coat diameters of our population were larger. Lantz (1930) reported diameters of 4-5 mm and Noble and Brady (op. cit.) 2-5 mm for northern populations. However, this may reflect differences in substrate moisture more so than genetic differences in egg size, since eggs swell considerably in response to changing moisture conditions.

Local populations often show strong preferences for certain microhabitats at breeding sites. For example, Graham (1971) found that 87% of nests at a breeding site in New Jersey were placed underneath surface objects (e.g., rocks and logs), while Noble and Brady (1933) reported populations near Washington, D.C. to show strong preferences for leaf litter microhabitat. Leaf litter was the preferred microhabitat for ovipositing at our study site even though logs which appeared suitable for egg deposition were present.

Local environmental regimes may possibly influence and explain nest microhabitat selection. At sites where stressful moisture conditions normally develop during the brooding season, the use of desiccation resistant surface objects would be advantageous. However, at sites where moisture stress is not significant, the use of leaf litter may be more advantageous since individuals would have greater freedom to position nests along elevational gradients at pool sites. The positioning of nests with respect to elevation may, in turn, greatly affect the survivorship of cohorts (Graham, 1971).

¹Variance values throughout this paper equal ± 1 standard deviation.

The advantage of brooding by *A. opacum* is not fully understood. Brooding in most species requires an energy cost to the parent(s) that is offset by the increased survivorship of offspring. Kaplan and Crump (1978) found that *A. opacum* females invest essentially no energy in brooding, since neither brooding nor non-brooding individuals feed during the brooding period. Selection for defense behavior and the production of presumably noxious tail secretions suggest that predators (i.e., raccoons, skunks) occasionally discover and destroy nests, although we have never observed any field evidence of this. Noble and Brady (1933) reported dusky salamanders (*Desmognathus fuscus*), two-lined salamanders (*Eurycea bislineata*) and green frogs (*Rana clamitans*) to prey on *A. opacum* eggs in unattended nests.

Bishop (1941) noted that eggs unaccompanied by females were smaller, and felt that the presence of females helped to reduce desiccation. Eggs in unattended nests at our study site were smaller (though not significantly so, $p = .12$) than those in attended nests, and tend to support this view. On two occasions nesting females that we were handling released large volumes of cloacal fluid, the function of which is unknown. Eggs that are removed from nests and rinsed often are prone to fungal attacks (unpublished data). It is possible that cloacal fluids protect against such attacks in addition to reducing desiccation. In any regard, the significant difference in average clutch sizes of attended versus unattended nests at our study site suggest that brooding effectively increases the survivorship of clutches.

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PATTERNS OF FOREST TENT CATERPILLAR DEFOLIATION
IN SOUTHWEST ALABAMA--1973-1979^{1,2}

James D. Harper

Department of Zoology-Entomology
Auburn University Agricultural Experiment Station
Auburn University, AL 36849

James R. Hyland

Alabama Forestry Commission
Montgomery, AL 36104

Abstract. An aerial survey of approximately 100,000 hectares of bottomland hardwood forest in the Mobile-Tensaw River basin and the lower Alabama and Tombigbee River basins of southwest Alabama was conducted annually from 1973 to 1979 to determine the extent of defoliation of water tupelo (*Nyssa aquatica* L.), sweetgum (*Liquidambar styraciflua* L.), and blackgum (*Nyssa sylvatica* var. *biflora* (Walt.) Sarg.) stands by the forest tent caterpillar, *Malacosoma disstria* Hübner. During the 7 year period, the area of defoliation varied from 11,240 to 36,891 hectares. Areas of heaviest defoliation alternated biennially within the ecosystem.

A chronically epidemic infestation of forest tent caterpillar, *Malacosoma disstria* Hübner, has existed in the Mobile-Tensaw River basin, extending north into the lower Alabama and Tombigbee River basins (Fig. 1), for many years. The preferred hosts in this area are water tupelo (*Nyssa aquatica* L.), blackgum (*Nyssa sylvatica* var. *biflora* (Walt.) Sarg.), and sweetgum (*Liquidambar styraciflua* L.). The area of infestation is normally limited to tupelo ponds within the flood plains of the above mentioned rivers where these species occur. Ponds are low areas between the complex, meandering rivers which are surrounded by natural levees, hold standing water for much of the year, and support dense stands of water tupelo and blackgum.

The forest tent caterpillar is univoltine, and larvae are normally active from the second week of March through the first week of May. However, this activity period may be advanced or delayed 7-10 days by climatic conditions in any given year. Defoliated trees normally begin to refoliate in late May. Surveys of defoliation damage, therefore, must be conducted during ca. a two-week period following cessation of feeding in order to observe maximum foliage losses.

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²We wish to thank Larry Abrahamson and Dan Botts for help in making several of the surveys. We also thank Terry Rodriguez for her artwork.

Forest Tent Caterpillar Defoliation

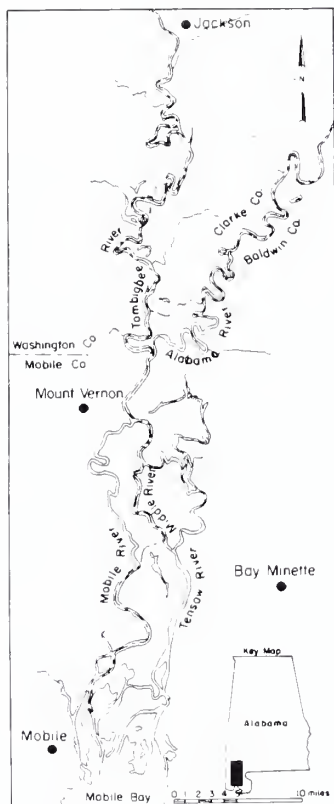


Figure 1. Area of southwestern Alabama which was aerially surveyed annually from 1973-1979 for forest tent caterpillar defoliation.

Surveys, with varying degrees of precision, of the extent and intensity of this defoliation were conducted by the U.S. Forest Service from 1960 through 1972 (with the exception of 1968 when no survey was made).^{3,4} In 1973, responsibility for the survey was assumed by the Alabama Forestry Commission and has since been conducted cooperatively by that agency and Auburn University. A compendium of the results of seven years of annual surveys are presented here. These and earlier surveys proved valuable for selection of study sites for previously reported work (Abrahamson and Harper 1973; Harper and Abrahamson 1979)⁵ and for several projects currently in progress (Harper, unpublished). In addition, they are contributing valuable data for studies on the population dynamics of forest tent caterpillar.

MATERIALS AND METHODS

Aerial surveys were made from single- or twin-engine airplanes flying at elevations of 750 to 1200 meters and airspeeds of ca. 200 km/hr. Predetermined flight lines with 3.2 km centers were drawn on photo index maps (scale 1 cm = 0.63 km). Infested areas were sketched on the maps by observers seated on each side of the plane as the flight lines were followed. In this manner, the entire area was surveyed in ca. two hours.

Forest stands were categorized as completely, partially, or not defoliated. Complete defoliation represented ca. 95% or greater loss of canopy foliage while

³Cambre, L. A. and W. H. Padgett. 1964. Aerial survey of forest tent caterpillar defoliation in Alabama. USDA For. Serv., State and Priv. For., Report No. Zone 2-5-64, 7 pp.

⁴Wilmore, D. H. and J. R. Hyland. 1972. Survey of forest tent caterpillar in southwest Alabama. USDA For. Serv., Southeastern Area, State and Priv. For., For. Pest Manage. Group Rep. 72-2-17, 3 pp.

⁵Abrahamson, L. P., J. D. Harper, I. R. Ragenovich, and J. R. Hyland. 1976. Pilot control project using trichlorfon and *Bacillus thuringiensis* against forest tent caterpillar in southwest Alabama. USDA For. Serv., Southeastern Area, State and Priv. For., For. Ins. and Dis. Manage. Report No. 77-1-76, 37 pp.

partial defoliation was characterized by stands with noticeably thinned foliage or a significant number of scattered trees showing heavy leaf loss. Damage in areas classed as non-defoliated was either non-existent or was too slight to be discernable from the air.

Completed survey maps were used to prepare a composite map of infested areas. Areas of partial and complete defoliation were then determined with a planimeter or an LI 3000 portable area meter (Lambda Instruments Corporation).

The optimum survey date each year was determined by ground observations for cessation of larval feeding activity. From 1973 through 1979, assessments were made on May 9, 13, 23, April 28, May 9, 15, and 9, respectively.

RESULTS AND DISCUSSION

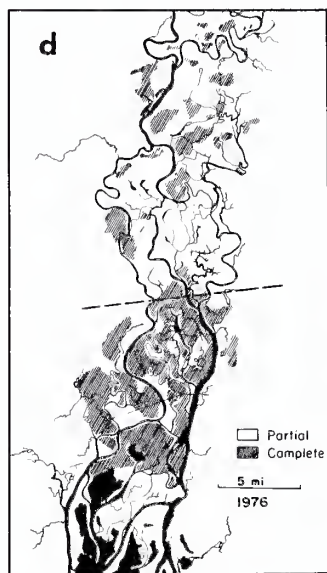
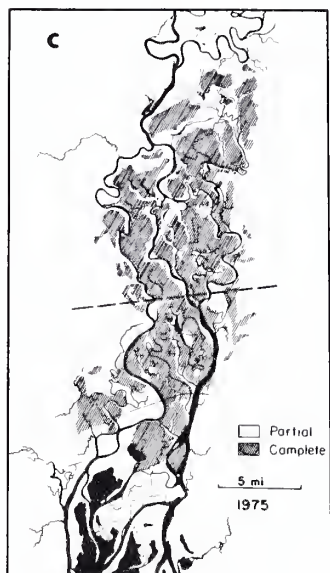
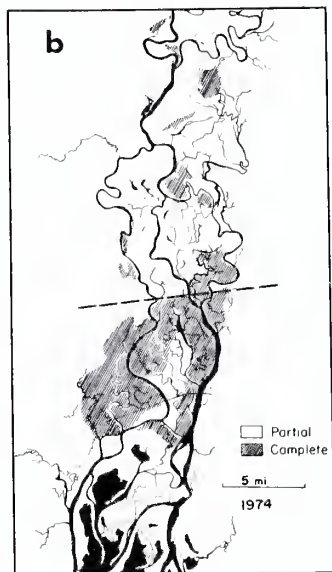
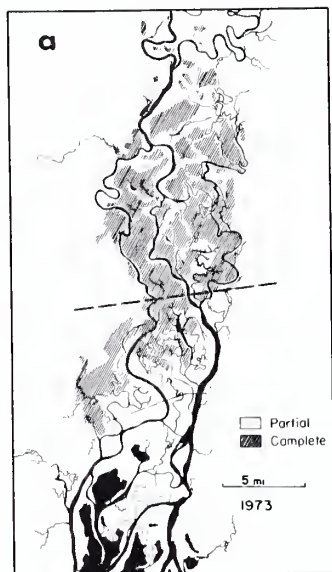
The total number of hectares showing either partial or complete defoliation over the 7 year period varied from 11,241 in 1979 to 36,891 in 1976 with all other years having intermediate infestations (Table 1). From 1973 to 1976, most areas of susceptible host between the junction of the Alabama and Tombigbee Rivers south to the southern extent of the host type suffered either partial or complete defoliation (Fig. 2a,b,c,d). In 1977 and 1979, extensive areas of the southern one-half of this area were free of detectable defoliation (Fig. 2e,g), while a major portion of the north-central basin was free of detectable defoliation in 1978 (Fig. 2f).

Table 1. Numbers of hectares of forest tent caterpillar defoliation in southwestern Alabama, 1973-1979

Year	Partially Defoliated	Completely Defoliated	Total
1973	9,086	15,464	24,550
1974	12,404	11,364	23,767
1975	6,772	20,980	27,752
1976	20,489	16,402	36,891
1977	8,624	16,693	25,317
1978	20,972	10,472	30,272
1979	9,990	14,740	24,730

Areas north of the junction of the Alabama and Tombigbee Rivers (Fig. 1) but not shown in Fig. 2 contain scattered tupelo ponds which occasionally show partial or complete defoliation. While these areas are not mapped, their averages are included in the figures in Table 1. From 1973 to 1979, these areas were 0, 538, 0, 6,727, 1,659, 9,176, and 1,025 hectares, respectively. Much of the area included in these values is not pure tupelo, but rather small, scattered stands in depressions

Forest Tent Caterpillar Defoliation



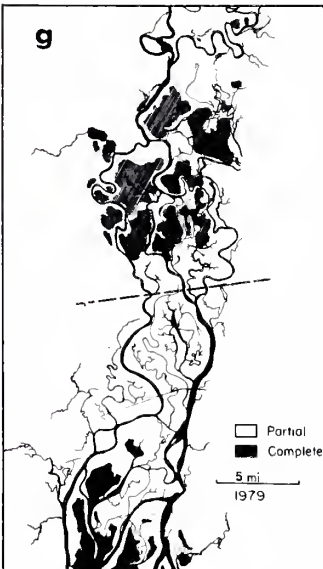
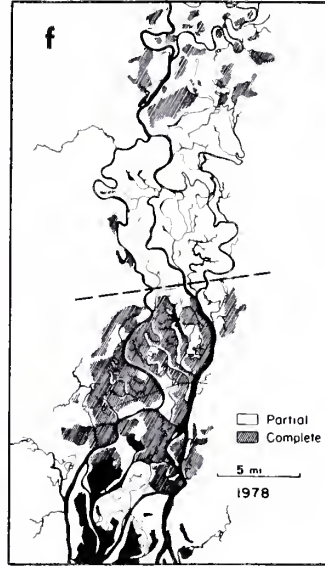
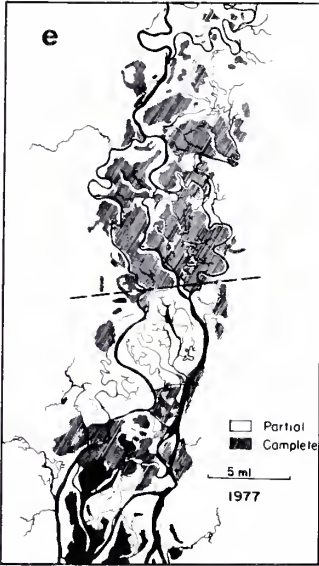


Figure 2. Areas of partial and complete defoliation of tupelo, blackgum and sweetgum forests in southwestern Alabama on (a) May 9, 1973, (b) May 13, 1974, (c) May 23, 1975, (d) April 28, 1976, (e) May 9, 1977, (f) May 15, 1978, and (g) May 9, 1979. Dashed line on each map indicates the narrowest point in the river basin.

Forest Tent Caterpillar Defoliation

interspersed among oak and other flood-plain species which are not normally defoliated. For survey purposes, it is impossible to precisely delineate the many small ponds involved. Thus, much of the large northern areas of infestation recorded for 1976 and 1978 include general areas of infested host type rather than precise numbers of hectares of host species defoliated.

A general tendency toward an annual fluctuation in degree of severity of defoliation has been noted in ground studies in the basin (Harper, unpublished) and has been supported by the defoliation patterns presented here. The central portion of the basin area appears to sustain alternating degrees of defoliation above and below a line drawn approximately east-west across the basin as indicated on Fig. 2. This is the narrowest portion of the basin and has been used as the crossing point for two major power lines and Interstate Route 65 (now under construction). Above this line, the majority of the infested area was completely defoliated in 1973 while the majority of the area below this line was partially defoliated (Fig. 2a). A similar pattern was noted in 1977 and 1979 (Fig. 2e,g). In 1975, heavy defoliation was prevalent in both areas but was less severe in the southern area. In 1974, 1976, and 1978, however (Fig. 2b,d,f), most heavy defoliation occurred below this line while the majority of the susceptible area north of the line was non- to partially defoliated. Thus, within each portion of the basin, severity of defoliation alternated annually between light and heavy, and the two portions were out of phase with each other. Reasons for these area patterns are unknown but are probably related to factors regulating individual pond populations.

A few ponds within the basin sustain defoliating populations almost continuously. Most populations, however, cycle from extreme low to extreme high levels. These cycles, which may require as few as two or as many as three to four years to complete in a given pond, are repeated continuously. It is evident that factors operating to maintain the species at endemic levels in more northerly and upland populations of forest tent caterpillar do not operate in this population. In northern areas of North America, outbreaks normally follow a three to six year cycle in a given host stand (Hodson 1977; Witter et al. 1975) with periods of six to sixteen years between outbreak initiation (Batzler and Morris 1978). Principle among these factors as reviewed by Witter et al. (1975), appear to be temperature (low winter temperatures, sub-freezing temperatures following egg hatch, extremely high temperatures during the moth emergence and oviposition period), starvation, disease, parasitism, and genetic attributes of the population. In Alabama, only starvation, as described previously, appears to be operating as a dominant regulatory factor.

Data gathered in numerous individual ponds (Harper, unpublished) suggests that extremely heavy populations are weakened by overcrowding and starvation following total defoliation of their host trees before larval development is completed. Egg masses produced by surviving females in such populations are low in numbers, size and quality, resulting in greatly reduced populations in the subsequent year. These in turn only partially defoliate the stands or do undetectable damage (when

viewed from the air), but a large percentage of larvae develop normally and resulting adults have high fecundity. Offspring in the succeeding year are often sufficiently numerous to defoliate their host trees, although this population buildup may require several years in some ponds.

In south Alabama, temperature conditions are near optimum for larval development. Winter temperatures below 0 degrees C are rare while temperatures during larval, pupal and adult developmental periods rarely exceed 30 degrees C or fall below 5 degrees C.

While parasitism and disease are present in various stages of host insect development, levels are not sufficient to permanently reduce populations (Stark and Harper, unpublished). Impact of both parasites and diseases appears to be severely limited by the aquatic environment. The soil, normally the pupation site for many dipterous and hymenopteran parasites and the reservoir for certain disease agents as discussed by Podgwaite et al. (1979), is unavailable for this purpose. Significant parasitism is thus limited to those species which do not leave their host to pupate. Disease incidence is presumed to be low because levels of available inoculum sufficient to initiate epizootics cannot normally be maintained in the environment, the soil being damp or covered with water for most of the year.

The net result of these factors is the poorly-moderated, continuously-cycling population pattern described. Examination of Fig. 2 reveals that individual ponds or areas may suffer from partial to complete defoliation for several years, but rarely is a given pond free from detectable defoliation for more than one year at a time.

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NOXIOUS WEEDS OF ALABAMA^{1,2}

Guy W. Karr, Jr.

Alabama Department of Agriculture and Industries

Plant Industry Section

P.O. Box 3336

Montgomery, AL 36193

Abstract. To detect and catalog the noxious weeds of Alabama, a survey of high hazard areas, state herbaria, and the literature was conducted during the summer and fall of 1979. A total of 40 species representing 19 families was detected. Two of the species detected, *Hydrilla verticillata* Royle and *Imperata brasiliensis* Trin., are listed as noxious weeds by the U.S. Department of Agriculture.

INTRODUCTION

Few can deny that weeds cause substantial losses to U.S. farmers. Anderson (1) reports that in the period from 1950-1960 "the estimated total cost of weeds in croplands, grazing lands, aquatic sites, and non-croplands was about \$5 billion." Approximately one-half of this was for weed control. A further indication of the problem comes from Klingman and Ashton (15) who report that in 1970 the "dollar value of herbicide sales is now greater than the combined value of insecticide and fungicide" sales.

Weeds may be dispersed in many ways, but the international spread of most weeds can be attributed mainly to the activities of man. Some plants such as water hyacinth (*Eichhornia crassipes*) and Japanese honeysuckle (*Lonicera japonica*) were introduced as ornamentals but later became important weed problems (26). Others such as kudzu (*Pueraria lobata*) (30) and cogongrass (*Imperata cylindrica*) (8) were introduced as forage crops only to become important pests.

Many universities import plants or plant parts for breeding purposes, use as forage crops or turf, or for research in weed control. Hoveland et al. (14) mention that more than 160 introductions of *Phalaris tuberosa*, mainly from the Mediterranean area, were tested in Alabama as potential forage crops.

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Other avenues of entry are areas where foreign cargo is unloaded such as docks, airports, and train depots. Many of the plants reported by Mohr (22) were collected from ship ballast piles near Mobile.

Since most of our serious weeds are of foreign origin, there developed much concern over the possibility of the introduction of additional serious weeds into the U.S. In 1966, the National Association of State Departments of Agriculture adopted a resolution requesting that the U.S. Congress enact a Federal noxious weed control law and set forth the guidelines which should be included in such a law. Finally, on January 4, 1975, President Gerald R. Ford signed into law the Federal Noxious Weed Act of 1974, Public Law 93-629 (26). The purpose of this law was "to provide for the control and eradication of noxious weeds, and the regulation of the movement in interstate or foreign commerce of noxious weeds and potential carriers thereof (2)." The law defines a noxious weed as "any living stage (including, but not limited to, seeds and reproductive parts) of any parasitic or other plant of a kind, or subdivision of a kind, which is of foreign origin, is new to or not widely prevalent in the United States, and can directly or indirectly injure crops, other useful plants, livestock, or poultry, or other interests of agriculture, including irrigation, or navigation or the fish or wildlife resources of the United States or the public health."

Few manuals (12, 26) devoted to the study of noxious weeds have been published. In 1977, Reed (26) published a book entitled Economically Important Foreign Weeds--Potential Problems in the United States. Reed (26) in writing this book conducted a "survey of the literature" in order to "determine how many noxious weeds of the world are not known to occur in the United States or, if present, have very limited distribution and which if introduced might cause serious problems." This publication lists approximately 1200 "foreign species" which "will doubtless be designated noxious weed species as defined by Public Law 93-629."

The present study was conducted to obtain an inventory of foreign noxious weeds occurring within the State of Alabama and to determine the need for a State noxious weed law.

METHODS

An extensive review of the literature was used to compile a list of weed species which might be classified as noxious by Public Law 93-629 (2). Included were taxa listed by Reed (26) and Holm et al. (12), plus those mentioned as being important new pests, introduced pests, or pests of increasing concern, by Auburn University Cooperative Extension Service personnel, weed scientists, plant taxonomists, and numerous other individuals concerned with crop production and/or weed control. The list contained approximately 1600 species and was used as a guide for checking herbaria.

In surveying herbarium collections, note was taken of any plant which was included on the preliminary list, and also of any additional plant labeled exotic, noxious, introduced, etc. Standard herbarium acronyms (13) are available for the two largest herbaria in Alabama;

others indicated were coined specifically for this study. The herbaria searched in this study were the Auburn University Herbarium (AUA, 35,000 collections), the University of Alabama Herbarium (UNA, 40,000 collections), the Jacksonville State University Herbarium (JS, 15,000 collections), the University of South Alabama Herbarium (SA, 7,000 collections), and the University of North Alabama Herbarium (NA, 2,000 collections).

A field survey of high hazard sites was conducted to detect possible noxious weeds in the field. High hazard sites are areas at which noxious weeds (or any pest for that matter) are most likely to be introduced. High hazard areas surveyed included the State Docks at Mobile and Montgomery, train depots at Birmingham, Huntsville, Mobile, and Montgomery, twelve Agricultural Experiment Stations, and numerous plant nurseries throughout Alabama.

Following these surveys, the list of suspected noxious weeds was compared with manuals and floras (9, 25, 29) commonly used in the southeastern U.S., and an annotated list was prepared.

RESULTS AND DISCUSSION

Forty Alabama species representing potentially noxious weeds were detected. Nineteen families were represented by one or more species, with the grass family (Poaceae) having the largest number, 10 species. The most common species, as indicated by herbarium records, were *Commelina erecta* and *Polygonum cespitosum*, which were both represented by collections from 13 different counties. Four species, *Bulbostylis capillaris*, *Ipomoea cairica*, *Lindernia crustacea*, and *Rhynchosia minima*, were not observed in herbaria; however, their mention by various authors (see annotated list) assures their occurrence in Alabama.

The herbarium collections observed appear to come from four general areas centered around Calhoun, Lee, Mobile, and Tuscaloosa counties. These areas are associated with universities and could reflect more intense collecting by taxonomists and students; also some of Alabama's Agricultural Experiment Stations are also associated with some of these areas. It is possible that plants being studied for forage escaped or that weed seed could have been introduced with crop seed and became established. Twenty-one of the 40 plants listed were collected in Mobile County. Mobile County would have to be considered the most likely area for new pest introductions due mainly to the large amount of foreign cargo brought into the port. A number of plants collected in Mobile County by Mohr (22) came from ships' ballasts which were dumped prior to taking on cargo. Dr. M. G. Lelong, University of South Alabama, (personal communication) has conducted intense surveys in Baldwin and Mobile counties and has reported collecting many plants listed by Reed (26). It is probable that additional collecting in Mobile County will yield more plants which may be designated as potentially noxious weeds.

All species included in the annotated list were mentioned by Reed (26), although 6 species, *Imperata cylindrica*, *Lolium temulentum*, *Setaria viridis*, *Polygonum lapathifolium*, *Portulaca oleracea*, and *Anagallis arvensis*, were not specifically treated. These weeds are included because

the plants actually treated by Reed (26) are similar to..., sometimes treated under..., considered a variation of..., etc. one of the 6 weeds noted above. Reed (26) reported that 14 of the 40 weeds did occur in the U.S., however, of the remaining 26 species, only 5, *Brachiaria eruciformis*, *Imperata cylindrica*, *Fatoua villosa*, *Trifolium subterraneum*, and *Myriophyllum propinquum*, were not reported as occurring in the U.S. by Fernald (9), Radford et al. (25), and Small (29).

Dr. Ronald L. Haaland, Auburn University (personal communication) is presently working with a number of plants including *Festuca arundinacea*, *Phalaris tuberosa*, and *Trifolium subterraneum* in an attempt to develop better forage crops. Reed (26) included all three of these as potential noxious weeds. Hoveland et al. (14) indicated that in 1974 there were 1 million acres of *Festuca arundinacea* in Alabama being used as winter forage for beef brood cow herds. Although these plants are not presently considered noxious weeds, it is apparent that more aggressive varieties might exist and could cause problems if introduced. It is important that new introductions of these plants be closely evaluated prior to being released because they are known to cause serious problems in certain areas of the world (see annotated list).

Of the 40 species listed, only 14 (Table 1) appear to fit the definition of a noxious weed as defined in Public Law 93-629 (2). These weeds are known to cause serious problems in some areas of the world (26) and have rather small distributions within the U.S. Two of the weeds listed in Table 1, *Hydrilla verticillata* and *Imperata brasiliensis*, have already been designated as noxious weeds by the U.S. Department of Agriculture (3).

No new specimens were collected during the survey of high hazard sites, thus the collection records and literature cited form the documentation for this report.

Several aquatic weeds not treated here were mentioned by Dr. Robert R. Haynes, University of Alabama, (personal communication) as probable recent introductions into Alabama. These include *Spirodela punctata*, *Myriophyllum brasiliensis*, *Myriophyllum spicatum*, *Ludwigia uruguayensis*, *Ludwigia peploides*, and *Najas minor*. Although aquatic plants are an integral part of the aquatic ecosystem, the introduction of certain exotics certainly may lead to severe water-use problems. These weeds merit close attention in the coming years.

Dr. Robert Kral, Vanderbilt University, (personal communication) indicated that *Phyllanthus tenellus* is most probably a recent introduction, and reports this weed from Escambia, Geneva, Sumter, and Lee counties in Alabama. This weed also merits watching in the coming years.

The results of this survey indicate that Alabama has a number of weeds which have the potential to develop into serious problems. This study also indicates the need for additional surveys to detect future plant introductions and also to monitor the spread of "noxious weeds" already known to occur within the state. Finally, the need for a State noxious weed law has been exhibited.

Noxious Weeds of Alabama

Table 1. Potentially noxious weeds as defined by the Federal Noxious Weed Act of 1974, Public Law 93-629.

<i>Brachiaria eruciformis</i>	<i>Imperata cylindrica</i>	<i>Lupinus luteus</i>
<i>Cenchrus brownii</i>	<i>Ipomoea cairica</i>	<i>Muscari comosum</i>
<i>Fatoua villosa</i>	<i>Koeleria phleoides</i>	<i>Myriophyllum propinquum</i>
<i>Hydrilla verticillata</i> ^a	<i>Lindernia crustacea</i>	<i>Phyllanthus urinaria</i>
<i>Imperata brasiliensis</i> ^a	<i>Ludwigia peruviana</i>	

^aAlready designated as noxious weeds by the U.S.D.A.

ANNOTATED LIST OF WEEDS DETECTED

The order of taxonomic treatment of families is that used by Radford et al. (25) which is generally accepted. Within each family the genera and species, respectively, are treated alphabetically.

Common names used are those recommended by the Weed Science Society of America (31) or when not listed by that agency, those used by Reed (26). Many of these weeds are not well enough known to have been given common names.

Within each family each weed is listed by scientific name and, when available, by common name. Following this is a note concerning areas in which the weed is known to cause serious problems, and this is followed by reports from the literature of the weed's occurrence in Alabama. Finally, herbarium specimens observed are listed by county, herbarium in which the specimen was observed, and the collection date. An abbreviated herbarium specimen citation is being used because this is not a taxonomic study and because we are more interested in collection locations and dates.

HYDROCHARITACEAE

Hydrilla verticillata Royle

hydrilla

An aquatic perennial known to cause serious problems in India and Japan (26). Reed (26) also notes that this weed has spread across the southern U.S. from FL to TX, and up into CO. Dennis (7) indicates that this weed was introduced into AL and several other states from FL. Bayne (unpublished report) reports *H. verticillata* from Barbour, Choctaw, and Elmore cos., AL.

Choctaw (UNA, 1978)

Clark (UNA, 1978)

H. verticillata is listed as a noxious weed by the U.S.D.A. under authority of the Federal Noxious Weed Act of 1974, Public Law 93-629 (3).

POACEAE

Brachiaria eruciformis (J.E.Sm.) Griseb.

signalgrass

An annual herb reported to occur in Mediterranean and Central Asian countries (26). Rutland (27) reports this weed from Lee Co., AL.

Lee (AUA, 1959)

Cenchrus brownii Roem. & Schult.

burrgrass

An annual herb reported to cause serious problems in Australia (26). Reed (26) also reports *C. brownei*, an apparent misspelling, as infrequent in the SE U.S.

Mobile (UNA, 1957)

Festuca arundinacea Schreb.

tall fescue

A perennial herb known to cause serious problems in Australia and New Zealand (26). Freeman and Moore (10) have reported that under some conditions this grass can cause livestock poisoning. Correll and Johnston (5) and apparently Radford et al. (25) consider *F. arundinacea* to be a synonym of *F. elatior*. Lelong (20) has reported *F. arundinacea* from Mobile Co., and Bostick (4) from St. Clair Co., AL. Lelong (personal communication) has collected this weed in Baldwin Co., AL.

Lee (AUA, 1968, 1970)

Marshall (AUA, 1960)

Mobile (SA, 1968)

Imperata brasiliensis Trin.

A perennial herb reported to occur in several South American countries (26). Hitchcock (11) reports this weed from southern FL and AL. Lelong (20, 21) reports *I. brasiliensis* from Mobile Co., AL.

Mobile (SA, 1968, 1969), (UNA, 1965)

I. brasiliensis is listed as a noxious weed by the U.S.D.A. under authority of the Federal Noxious Weed Act of 1974, Public Law 93-629 (3).

Imperata cylindrica (L.) Beauv.

cogongrass

Reed (26) actually refers to *I. cylindrica* var. *major* (Nees) C. B. Hubb. ex Hubb. & Vaughan and mentions that it causes serious problems in New South Wales. Hitchcock (11) makes no mention of *I. cylindrica* var. *major*. Holm et al. (12) list *I. cylindrica* as the world's seventh worst weed. Dickens (8) reports *I. cylindrica* from Baldwin, Choctaw, Conecuh, Escambia, Geneva, Pike, Mobile and Washington cos. of AL.

Mobile (AUA, 1956)

Koeleria phleoides (Vill.) Pers.

An annual herb reported to cause serious problems in Russia (26). Small (29) reports this grass from AL, and Hitchcock (11) and Lelong (21) have reported it from Mobile Co., AL.

Mobile (SA, 1971)

Lolium temulentum L.

darnel

Reed (26) actually refers to *L. cuneatum* Nevski but indicates that it is "considered by some as *L. temulentum*." Hitchcock (11) makes no mention of *L. cuneatum*. *L. cuneatum* is an annual herb known to cause serious problems in Russia (26). Freeman and Moore (10) report that

Noxious Weeds of Alabama

under some conditions *L. temulentum* can cause livestock poisoning. Radford et al. (25) report *L. temulentum* from AL and other SE states, and Rutland (27) and Mohr (22) report it from Lee and Mobile cos., AL, respectively.

Dallas (AUA, 1959)
Greene (UNA, 1967)
Hale (UNA, 1966)
Lee (AUA, 1952, 1970)
Mobile (UNA, 1964)

Paspalum vaginatum Swartz

salt-water couch

A perennial herb reportedly causing serious problems in Taiwan (26). Radford et al. (25) report this grass from AL, and Mohr (22) reports it from Mobile and Baldwin cos., AL.

Baldwin (AUA, 1952)
Mobile (UNA, 1966), (SA, 1967)

Phalaris tuberosa L.

Reed (26) actually refers to *P. bulbosa* L. and considers *P. tuberosa* a synonym of *P. bulbosa*. Hitchcock (11) on the other hand considers *P. bulbosa* to be a synonym of *Phleum subulatum* (Savi) Asch. & Graebn. and treats *P. tuberosa* as a valid species. *P. bulbosa* is a perennial herb known to cause serious problems in Lebanon, New Zealand, and Hawaii (26). Reed (26) also reports that *P. bulbosa* is cultivated for forage in TX and MS. Rutland (27) reports *P. tuberosa*, also a perennial herb from Lee Co., AL.

Elmore (AUA, 1959, 1963)

Setaria viridis (L.) Beauv.

green foxtail

Reed (26) actually refers to *S. gigantea* (Fr. & Sav.) Makino but suggests that it is "most probably only a variation of *S. viridis*." Both are annuals with *S. gigantea* described as a "slightly harmful weed" in Japan (26). Hitchcock (11) makes no reference to *S. gigantea*. Mohr (22), who indicates that *S. viridis* is a synonym of *Chaetochloa viridis* (L.) Scribner, reports this weed from Mobile Co., AL. Rutland (27) reports *S. viridis* from Lee Co., AL.

Calhoun (JS, 1968)
Lee (AUA, 1966)

CYPERACEAE

Bulbostylis barbata (Rottboell) Clarke

An annual herb which causes serious problems in Japan and Taiwan (26). Radford et al. (25) and Small (29), who calls this weed *Stenophyllus barbatus* (Rottboell) Britton, both report this weed from AL in addition to other SE states. In AL *B. barbata* has been reported from Elmore, Lee (27), and Mobile (20) cos. In addition, Kral (16) has reported this species from seventeen other AL cos.

Geneva (AUA, 1968)
Henry (AUA, 1968)

Lee (AUA, 1955)
Mobile (SA, 1967)

Bulbostylis capillaris (L.) Clarke

Reed (26) actually refers to *B. densa* (Wall.) Hand.-Mazz. instead but mentions that *B. capillaris* var. *trifida* Clarke is a synonym of *B. densa*. Kral (16) does not mention *B. densa* or *B. capillaris* var. *trifida* in his treatment of North American species of *Bulbostylis*, but does list *B. capillaris* var. *isopoda* Fern. among others as a synonym of *B. capillaris*. It should be pointed out that, if *B. capillaris* var. *trifida* is segregated from *B. capillaris*, the remaining varieties of *B. capillaris* may not be noxious at all. *B. densa* is an annual herb known to cause serious problems in Japan (26). Radford et al. (25) report *B. capillaris* from AL and other SE states. Fernald (9) mentions that *B. capillaris* var. *isopoda* occurs in AL. *B. capillaris* has been reported from Chambers, Elmore, Randolph, Talladega (27), Clay (22), and St. Clair (4) cos. of AL, while Kral (16) reports this species from twenty-four AL cos.

No herbarium specimens observed.

Cyperus polystachyos Rottboell

A perennial herb which causes serious problems in India and Taiwan (26). *C. polystachyos* var. *texensis* (Torrey) Fernald is an American variety which has been reported as occurring throughout the SE U.S. (25). Radford et al. (25) list *C. microdontis* Torrey among others as a synonym of *C. polystachyos* var. *texensis*. Mohr (22) reports *C. microdontis* from Mobile and Baldwin cos., AL, while Lelong (20) reports *C. polystachyos* from Mobile Co., AL.

Mobile (UNA, 1965)
Wilcox (UNA, 1978)

Fimbristylis miliacea (L.) Vahl.

grass-like fimbristylis

An annual herb reported to cause serious problems in Taiwan, Japan, and the Philippine Islands (26). This weed has been reported from AL and other SE states by Radford et al. (25). Rutland (27) reports this weed from Lee Co., AL, and Lelong (20) from Mobile Co., AL, while Kral (16) reports it from twelve other AL cos.

Dallas (UNA, 1977)
Lee (AUA, 1950, 1962)
Mobile (SA, 1969)
Montgomery (UNA, 1977)
Tuscaloosa (UNA, 1977)

COMMELINACEAE

Aneilema nudiflorum (L.) Kunth

An annual herb which causes serious problems in India (26). Lelong (19, 20) reports this weed as "infrequent in moist, cultivated sites" of Mobile Co., AL.

Mobile (AUA, 1956), (SA, 1968)

Noxious Weeds of Alabama

Commelina erecta L.

A perennial herb reported to cause serious problems in Ghana (26). Although Reed (26) does not mention the occurrence of this weed in the U.S. specifically, he does mention its occurrence in the "New World." Radford et al. (25) indicate that this weed occurs throughout the SE U.S. *C. erecta* has been reported from Cleburne, Coosa, Randolph (27), Lee (22), Mobile (20, 22), and St. Clair (4) cos. of AL.

Cleburne (AUA, 1975)	Mobile (SA, 1967), (UNA, 1965)
Coosa (AUA, 1973)	Montgomery (AUA, 1967)
Elmore (AUA, 1975)	Perry (AUA, 1976)
Escambia (AUA, 1968)	Randolph (AUA, 1967)
Lowndes (JS, 1969)	Tallapoosa (AUA, 1969)
Macon (AUA, 1971)	Tuscaloosa (UNA, 1966)
Marshall (UNA, 1956)	

Tradescantia fluminensis Vell.

A perennial herb which reportedly causes serious problems in New South Wales (26). There are no known reports of the occurrence of this weed in AL.

Baldwin (SA, 1971)

LILIACEAE

Muscari comosum (L.) Mill.

purple grape-hyacinth

A perennial herb which reportedly causes serious problems in Lebanon (26). Reed (26) also mentions that *M. comosum* is often cultivated as an ornamental in North America. Rutland (27) reports this plant from Lee Co., AL where it probably escaped from cultivation.

Lee (AUA, 1922)

MORACEAE

Fatoua villosa (Thunb.) Nakai

An annual herb reported to cause serious problems in Japan (26). Lelong (19, 20) reports this weed from Mobile Co., AL.

Mobile (SA, 1972)

POLYGONACEAE

Polygonum cespitosum Bl.

An annual herb noted as being a serious problem in Taiwan (26). Fernald (9) and Radford et al. (25) make note of *P. cespitosum* var. *longisetum* (De Bruyn) Stewart rather than the typical variety *P. cespitosum*. In AL *P. cespitosum* var. *longisetum* has been reported from Tallapoosa (24, 27), Chambers, Clay, Lee (27), Bibb, Dallas, Jefferson, Perry, and Shelby cos. (28). Lelong (personal communication) has collected this weed in Mobile Co., AL.

Bibb (UNA, 1976)
 Blount (UNA, 1978)
 Calhoun (AUA, 1975)
 Clay (UNA, 1978)
 Cleburne (AUA, 1975)
 Coosa (AUA, 1975)
 Dallas (AUA, 1976)

Lee (AUA, 1955, 1970)
 Montgomery (UNA, 1977)
 Shelby (AUA, 1976)
 Talladega (AUA, 1975)
 Tallapoosa (AUA, 1974)
 Tuscaloosa (UNA, 1966)

Polygonum lapathifolium L.

pale smartweed

Reed (26) actually refers to *P. linicola* Sut. but mentions that it is "sometimes treated under *P. lapathifolium*." *P. linicola* is an annual herb known to cause serious problems in Russia (26). Radford et al. (25) report *P. lapathifolium*, also an annual herb, from AL and other SE states. In AL *P. lapathifolium* has been reported from Bibb (28), Cleburne, Lee (27), Mobile (20, 22), and St. Clair cos. (4). Lelong (personal communication) has collected this weed in Baldwin Co., AL.

Calhoun (JS, 1969)
 Dallas (UNA, 1977)
 Tuscaloosa (UNA, 1977)
 Wilcox (UNA, 1978)

AIZOACEAE

Trianthema portulacastrum L.

horse purslane

An annual succulent herb which causes serious problems in India and Madras (26). Reed (26) has apparently misspelled the genus ("*Trianthema*"). Radford et al. (25) report this weed from AL.

Jefferson (UNA, 1944)

PORTULACACEAE

Portulaca oleracea L.

common purslane

Reed (26) actually refers to *P. quadrifida* L. but indicates that it is "sometimes considered a form of *P. oleracea*." Both species are annual herbs. *P. quadrifida* is known to cause serious problems in Taiwan and India (26). Holm et al. (12) list *P. oleracea* as the world's ninth worst weed. Radford et al. (25) report *P. oleracea* as occurring throughout the SE U.S., and Mohr (22) reports this weed as occurring throughout AL. Sessler (28) and Lelong (20) have reported *P. oleracea* from Dallas and Mobile cos., AL respectively. Lelong (personal communication) has collected this weed in Baldwin Co., AL.

Dallas (AUA, 1976)
 Mobile (UNA, 1965), (SA, 1974)

CARYOPHYLLACEAE

Silene gallica L.

English catchfly

Reed (26) indicates that *S. gallica* is a synonym of *S. gallica* var. *quinquevulnera* (L.) Koch. It has been reported that *S. gallica* var. *quinquevulnera*, an annual herb, causes serious problems in Japan and New

Noxious Weeds of Alabama

South Wales, and is known to occur in the U.S. (26). Mohr (22) indicates that *S. gallica* is a synonym of *S. anglica* L. and reports the latter from Mobile Co., AL. Kral (17) also reports *S. gallica* from Mobile Co., AL. Macon (AUA, 1967)

RANUNCULACEAE

Ranunculus acris L. tall buttercup

A perennial herb reported to cause serious problems in Russia, Germany, and Trinidad (26). Reed (26) also indicates that this weed occurs in NE America. Mohr (22) reports *R. acris* as "rare" in Mobile Co., AL.

Mobile (UNA, 1985)

FABACEAE

Lupinus luteus L. yellow lupine

An annual herb which causes serious problems in South Africa and Russia (26). In addition Reed (26) reports *L. luteus* as occurring in North America. In AL this weed has been reported from Lee Co. (27).

No herbarium specimens observed.

Medicago polymorpha L. toothed medic

An annual herb reported to cause serious problems in India, Russia, Japan and New Zealand (26). Reed (26) also indicates that this weed is more or less worldwide in distribution but fails to mention its occurrence in the U.S. Radford et al. (25) report *M. polymorpha* from AL and other SE states. Mohr (22) reports *M. denticulata* Willd., a synonym of *M. polymorpha* from Mobile Co., AL, and Rutland (27) reports *M. polymorpha* from Lee Co., AL.

Green (UNA, 1967)

Lee (JS, 1964)

Marengo (UNA, 1969)

Mobile (UNA, 1974)

Sumter (UNA, 1967)

Rhynchosia minima (L.) DC

An annual herb reportedly causing serious problems in India (26). Mohr (22) reports the occurrence of this weed from Mobile Co., AL.

No herbarium specimens observed.

Trifolium subterraneum L. subterranean clover

An annual herb which causes serious problems in New Zealand and Tasmania (26). Rutland (27) has reported this weed from Tallapoosa Co., AL.

Tallapoosa (NA, 1972)

EUPHORBIACEAE

Euphorbia heterophylla L.

wild poinsettia

An annual herb which causes serious problems in India and Trinidad (26). Correll and Johnston (5) indicate that *E. cyathophora* Murr. is often erroneously included under *E. heterophylla*. Radford et al. (25) report this weed from AL in addition to other SE states. Lelong (20) has reported *E. heterophylla* from Mobile Co., AL.

Elmore (AUA, 1970)

Houston (AUA, 1969)

Mobile (SA, 1968)

Montgomery (UNA, 1949, 1969)

Phyllanthus urinaria L.

An annual herb reported to cause serious problems in Japan and Taiwan, and is noted by Reed (26) as occurring in tropical North America. Lelong (19, 20) reports this weed from Mobile Co., AL, and Kral (personal communication) reports it from Baldwin, Barbour, Covington, Escambia, Lee and Mobile cos. of AL.

Mobile (SA, 1969)

ONAGRACEAE

Ludwigia peruviana (L.) Hara

A perennial shrub known to cause serious problems in Columbia (26). In addition Reed (26) reports this aquatic weed as occurring in FL. Mohr (22) reports *Jussiaea peruviana* L., a synonym of *L. peruviana*, from Mobile Co., AL.

Mobile (SA, 1974)

HALORAGACEAE

Myriophyllum propinquum A. Cunn.

An aquatic perennial herb known to cause serious problems in New Zealand (26). No known previous reports of this weed occurring in AL. Lauderdale (UNA, 1978)

PRIMULACEAE

Anagalis arvensis L.

scarlet pimpernel

Reed (26) refers here to *A. foemina* Mill. but indicates that it is "very similar to *A. arvensis*." *A. foemina* is an annual or biennial herb reported to cause serious problems in Russia, Israel and Lebanon (26). Radford et al. (25) report *A. arvensis*, an annual herb, from AL, and Rutland (27) and Mohr (22) report this weed from Lee and Mobile cos., AL, respectively.

Lee (AUA, 1953)

Mobile (SA, 1974), (UNA, 1950)

Noxious Weeds of Alabama

CONVOLVULACEAE

Ipomoea cairica (L.) Sweet

Cairo morningglory

A perennial herb known to cause serious problems in India (26). Kral (18) reports this weed from Mobile Co., AL.
No herbarium specimens observed.

SCROPHULARIACEAE

Lindernia crustacea (L.) F. Muell.

An annual herb reportedly causing serious problems in India and Taiwan (26). Reed (26) does mention the occurrence of this weed in America. Kral (17) reports *L. crustacea* from Escambia Co., AL.
No herbarium specimens observed.

Mazus japonicus Mak.

Reed (26) actually refers to *M. miquelli* Mak. but notes that *M. japonicus* is a synonym of *M. miquelli*. *M. miquelli* is a perennial herb which is a "harmful weed throughout" Japan (26). Lelong (19, 20) reports *M. japonicus* from Mobile Co., AL.
Mobile (SA, 1969)

ASTERACEAE

Lactuca virosa L.

bitter lettuce

An annual or biennial herb which causes serious problems in France and S. Australia (26). Reed (26) also reports *L. virosa* from CA. There is no previous mention in the literature of the occurrence of this weed in AL.
Tuscaloosa (UNA, 1957)

Melanthera hastata Michaux

Reed (26) actually refers to *M. nivea* (L.) Small and indicates that *M. hastata* is a synonym of *M. nivea*, a treatment also followed by Parks (23) and Cronquist (6). The species is reported by Reed (26) as occurring along the Coastal Plain from SC to LA. It has been reported from Bibb (28) and Mobile (22) cos., AL as *M. hastata*, and from Barbour, Colbert, Mobile, and Morgan cos., AL (23) as *M. nivea*.

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ABSTRACT
Alabama Science Policy Forum

HYDROGEN, OXYGEN, AND POTABLE WATER PRODUCTION FROM FISSION

D. L. Hollis. Dept. of Electrical Engineering. E. R. VanArtsdalen.
Dept. of Chemistry, Univ. of Ala., University, AL 35486.

A reexamination is made of producing hydrogen from radiolytic decomposition of water in an aqueous homogeneous fission reactor. For economical reasons the by-product of potable water distilled from salt water is included, and it is assumed that oxygen is released with the hydrogen. Based on published data without any attempt to increase production rates beyond that reported, a 3000 MWt reactor will produce 81 tonnes/d of H_2 , 648 tonnes/d of O_2 , and 148(10⁶) gal/d of potable water.

The hydrogen production rate is too low, but potable water production is attractive enough to reverse its role of by-product. By keeping the reactor power density small with a large core, advantages in safety and corrosion are expected. Inadvertent hydrogen combustion should be controlled by predominant water vapor concentration. Tritium production, though little, could result in concentrations greater than the MPC¹_{air} for internal combustion engines in enclosed spaces. Until tritium removal systems are available, hydrogen from fission should be used in fuel cells or aircraft. In addition to tritium removal, the main problem identified is a need for better understanding of fission product interaction with water in order to increase hydrogen production from fission.

NOTES

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GRANULOMAS IN REPTILES: A REPORT OF FOUR CASES¹

Charles G. Crispens, Jr. and Ken R. Marion

Department of Biology
University of Alabama in Birmingham
University Station, Birmingham, AL 35294

Abstract. Four examples of subcutaneous granulomas were found over a period of approximately two years in reptiles collected and/or maintained in the southeastern United States. These included a granuloma of bacterial etiology in a Gulf Coast box turtle and three cases of mycotic granulomas in a boa constrictor, a panamint rattlesnake and a dusky pigmy rattlesnake.

Reptiles have been collected and exhibited by zoos for many years, and their value as laboratory animals has increased considerably during the past decade. Nonetheless, an understanding of the infectious diseases of these vertebrates is incomplete.

It would appear that bacterial infections are common in reptiles. Two reviews list numerous examples of such diseases^{10,11}; other articles describe additional cases in various species of reptiles¹², an acid-fast granuloma in the eye of a box turtle (*Terrapene carolina*)⁹, and granulomatous pseudotumors in several specimens of lizards (*Lacerta sicula*) and the iguana (*Cyclura cornuta*)². By comparison, there have been few observations of mycotic diseases. These include descriptions of mycotic pneumonia in turtles and tortoises⁸, captive giant tortoises (*Testudo elephantopus* and *T. gigantea elephantina*)⁶, and captive American alligators (*Alligator mississippiensis*)⁵, as well as three examples of fungal infections in the eyes of a rainbow boa (*Epicrates chenchria maurus*)¹⁴, the jaw and internal organs of a tropical tortoise (*Testudo radiata*) and the skin of a reticulated python (*Python reticulatus*)⁴.

Reports of algal infections in reptiles are rare³. Several years ago, we described a lesion which developed slowly on the ventro-lateral surface of the neck of a male corn snake (*Elaphe guttata guttata*) and recurred as a fulminating subcutaneous mass within a few weeks after surgery¹. Microscopic examination allowed for the tentative identification as a chondrosarcoma, but this interpretation was corrected by participants in a National Cancer Institute Pathology Conference who diagnosed the growth as a parasitic granuloma of algal (*Protothecosa* sp.) etiology.

Recently, we were afforded the opportunity to study a series of subcutaneous lesions which occurred over a period of approximately two

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Granulomas in Reptiles

years in four species of reptiles. These cases now have diagnoses. They are reported herein to allow for incorporation into the present knowledge of reptilian diseases.

MATERIALS AND METHODS

The methods employed were similar for each specimen. Thus, pieces of tissue were obtained at necropsy (or removed surgically), fixed in 10% neutral formalin, and embedded in paraffin for sectioning. Some sections were stained with hematoxylin and eosin for examination with the light microscope and, if warranted, additional sections were stained with special methods such as Brown and Breen, Gomori methenamine silver, and periodic acid-Schiff⁷. Thereafter, representative slides and the unused portions of tissue blocks were submitted with pertinent information to the Registry of Tumors in Lower Animals (RTLA), The Smithsonian Institution.

RESULTS AND DISCUSSION

Bacterial Infections

The only example of a bacterial infection occurred in a female Gulf Coast box turtle (*Terrapene carolina major*). This animal was collected in southern Mississippi (Jackson County) on June 16, 1975 and, at the time of capture, showed a prominent swelling on the dorsal surface of the neck. Six months later, a single subcutaneous mass was excised by routine surgical procedures. The lesion measured 13 mm in diameter and was encapsulated. The capsular portion was reddish-brown; the central region appeared lighter in coloration and was firm. To date, there has been no recurrence of the disease process.

Microscopic examination revealed an infectious granuloma of bacterial etiology (RTLA 1380). Further, it was indicative of an old lesion since only the peripheral granulation tissue had not become necrotic.

The repeated observation of bacterial granulomas on turtles, snakes, and lizards has led to the suggestion that reptiles may be stung frequently and infected mechanically by insects (Harshbarger, J. C., *personal communication*). However, this mechanism has yet to be proved as a significant means of infection.

Mycotic Infections

Mycotic infections were found in three species of snakes.

One snake, a male boa constrictor (*Boa constrictor*), had been in captivity for eight years. It developed multiple subcutaneous growths which were variable in size (0.5-1.5 cm in the greatest dimension) and of wide distribution over the lateral and dorsal surfaces of the body. Treatment was attempted by excision of the lesions, but the snake died within several hours after surgery.

The second case involved a female panamint rattlesnake (*Crotalus mitchelli*) which was obtained as an adult and maintained in the collection of the Birmingham Zoo for approximately five years. The initial growth was observed after one year. When killed, there were multiple subcutaneous lesions which varied in size and exhibited a wide distribution over the lateral and dorsal surfaces of the body. The largest growth measured $4.0 \times 1.5 \times 2.0$ cm in length, height and width, respectively. Its surface, as well as the surfaces of many of the smaller lesions, was marked by extensive ulceration.

The third snake, a female dusky pigmy rattlesnake (*Sistrurus miliarius*), was collected in Florida (Jackson County) on August 21, 1976. At capture, a small growth was noted behind the angle of the lower jaw. Thereafter, the lesion exhibited a slight increase in size and, when removed by routine surgical procedures, it measured approximately 5 mm in diameter. To date, there has been no recurrence of the disease process.

In general, the lesions presented similar macroscopic features. Each appeared as a firm and encapsulated subcutaneous mass. The capsular portion was reddish-brown; the central region varied from pinkish-white to grayish-white in coloration.

Microscopic examination allowed for a diagnosis of mycotic granuloma in the three snakes: *B. constrictor* (RTLA 1131), *C. mitchelli* (RTLA 1230) and *S. miliarius* (RTLA 1604). Thus, each lesion was characterized by multiple foci of necrosis surrounded by large numbers of granulocytes and macrophages. Fungal hyphae could be seen in sections stained with hematoxylin and eosin, and these were better demonstrated by application of the periodic acid-Schiff technique (Figure 1).

Our finding of mycotic granulomas in three of the four cases raises the question of whether mycotic infections are more common in reptiles than previous studies have indicated^{4,13}. In this regard, the fact that two of the reptiles were maintained in captivity may be of importance since it is often difficult to recreate their appropriate environment and diet. Changes from normal may greatly reduce their resistance to disease, and fungal infections are known to develop under such conditions⁶.

We also suspect that geographic location may be a factor. The high humidity and extended periods of warm temperature characteristic of the southeastern United States present a favorable environment for most mycotic forms. Thus, there is a need for further information on reptiles collected and/or maintained in this region.

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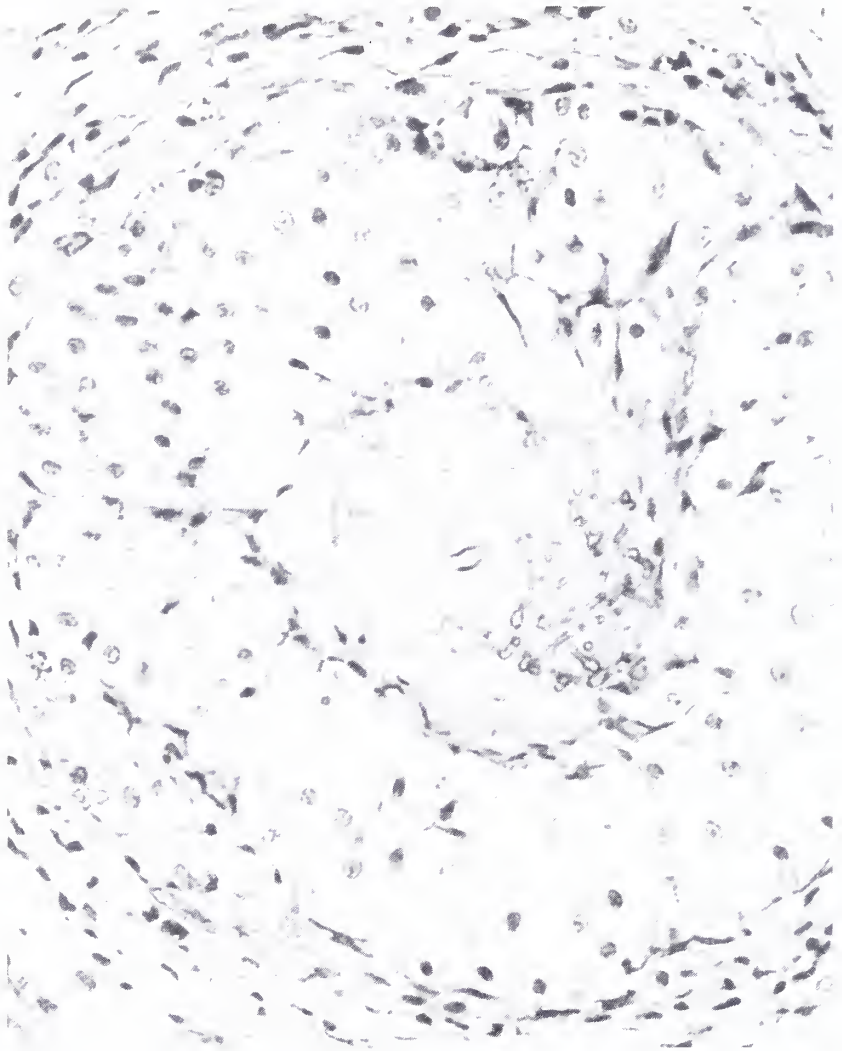


Figure 1. Mycotic granuloma in *S. miliaris*. Fungal hyphae are evident in a core of necrotic material. Around the core, there is a zone of inflammation which shows infiltration with granulocytes and macrophages. Periodic acid-Schiff stain. Original magnification X315.

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FECUNDITY OF LARGEMOUTH BASS FROM PICKWICK
RESERVOIR, TENNESSEE RIVER^{1,2}

Daniel F. Hughes
Department of Biology
University of North Alabama
Florence, AL 35630

Wayne A. Hubert³
Tennessee Valley Authority
Division of Water Resources
Muscle Shoals, AL 35660

Abstract. Fecundity of largemouth bass was estimated from observations of 37 fish (292-577 mm total length) collected prior to spawning from Pickwick Reservoir. Estimated fecundity ranged from 4,700 to 79,900 ova per female and was correlated to total length and weight. Fecundity of Pickwick Reservoir fish was compared to other localities.

INTRODUCTION

Numerous descriptions of fecundity of largemouth bass, *Micropterus salmoides*, have been performed (Carlander 1977), but few studies have presented statistical analyses allowing prediction of fecundity from knowledge of fish sizes. The present study was carried out to achieve better understanding of the relation between the size of largemouth bass and fecundity, that is the annual number of potentially fertile ova produced by a female (Ruelle 1977).

STUDY AREA

Pickwick Dam, Tennessee River Mile (TRM) 206.7, is the second in a series of mainstream dams on the Tennessee River and impounds 17,400 ha at full pool. The upstream boundary of Pickwick Reservoir, Wilson Dam (TRM 259.4), discharges a mean volume of 1,000 m³/second into Pickwick Reservoir. From Wilson Dam downstream 20 km, the river flows within its original banks and is distinctly lotic. Downstream from this point, the river spreads out to inundate the floodplain and form a more lentic habitat. Pickwick Reservoir is a relatively old impoundment; the dam was closed in 1938.

¹Manuscript received 2 February 1981; accepted 23 March 1981.

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³Present address: Iowa Cooperative Fishery Research Unit, Iowa State University, Ames, Iowa 50011.

MATERIALS AND METHODS

Largemouth bass were collected by angling and electrofishing in March, April and May of 1974 and 1975. Total length (TL) in millimeters and weight in grams were measured. Ovaries were removed and placed in 10% formalin.

Potentially fertile ova were identified on the basis of size and appearance. Kelley (1962) estimated the size range of potentially fertile ova to be 0.75 to 1.56 mm in diameter. All ova in this size range contained yolk and were considered mature by James' (1946) description of ova development. Ova diameter frequency distributions computed for 12 Pickwick Reservoir largemouth bass confirmed the previous observations; therefore, all ova greater than 0.75 mm were considered potentially fertile or mature.

Midregion ovary cross sections were divided into 1- to 2-gram wedges, yielding 1,000 to 2,000 ova per sample. Ova were teased from connective tissue with a probe and forceps and placed around the periphery of a petri dish to be counted and measured. Ova diameters were measured to the nearest 0.06 mm at 10x with an ocular micrometer as they appeared on the horizontal scale of the micrometer (Timmons, et al. 1980). To estimate fecundity for each specimen, the total number of potentially fertile ova in a midregion sample was expanded by the ratio of total ovary weight (both ovaries) to sample weight.

RESULTS AND DISCUSSION

Ovaries from 77 largemouth bass (190-577 mm TL) were examined. Thirty-seven fish were found to contain ova greater than 0.75 mm in diameter; estimated fecundity ranged from 4,700 to 79,900 mature ova per female (Table 1).

Regression analyses were performed to describe the relations between estimated fecundity and total length and weight. The estimated fecundity versus total length relationship ($r = 0.88$) was:

$$F = 249.33L - 73,221$$

where, F = estimated fecundity and L = total length in millimeters. A better predictive ability was observed from knowledge of weight ($r = 0.92$):

$$F = 27.29W - 4,616$$

where, F = estimated fecundity and W = weight in grams. Higher order equations did not improve predictability.

The estimated fecundity of Pickwick Reservoir largemouth bass at specific lengths was compared to other studies (Table 2). At 300 mm TL the predicted fecundity of Pickwick Reservoir fish was lower than in other locations, but at 400 and 500 mm TL comparable estimates were observed. It has been found that Pickwick Reservoir largemouth bass grow

Fecundity of Largemouth Bass

Table 1. Estimated effective fecundity of 37 largemouth bass from Pickwick Reservoir.

Specimen Number	Date Collected	Total Length (mm)	Total Weight (g)	Estimated Effective Fecundity
1	4-28-75	292	372	7,783
2	4-9-74	305	454	23,455
3	5-10-75	312	454	4,746
4	5-5-75	315	454	15,028
5	4-15-75	328	499	9,988
6	4-9-74	330	680	9,175
7	5-10-75	333	540	12,202
8	4-26-75	335	726	20,274
9	5-10-75	345	590	11,699
10	4-26-75	348	726	9,237
11	4-28-75	348	762	7,911
12	4-25-74	353	680	12,977
13	5-5-75	356	862	23,318
14	4-26-75	368	680	5,152
15	5-10-75	368	771	9,257
16	4-26-75	378	640	13,858
17	5-10-75	381	726	20,895
18	5-20-75	384	907	17,254
19	5-7-74	394	680	14,669
20	5-10-75	394	862	14,476
21	4-15-75	419	1,225	40,475
22	5-7-74	419	1,270	12,580
23	5-12-75	422	1,139	11,622
24	4-15-75	432	1,452	35,966
25	5-12-75	434	1,125	22,641
26	4-15-75	439	1,406	44,670
27	5-12-75	439	1,420	32,492
28	4-15-75	481	2,359	57,580
29	3-17-74	488	2,194	55,371
30	5-10-75	521	2,041	52,583
31	3-17-74	521	2,240	79,869
32	4-13-75	526	2,359	74,896
33	3-9-74	533	2,423	73,911
34	4-28-75	536	2,586	51,506
35	3-17-74	554	2,514	62,544
36	3-17-74	559	2,926	78,514
37	5-10-75	577	2,722	46,757

slower than bass in other southeastern reservoirs (Hubert 1975). The low fecundity among small fish may be related to factors which also limit growth of Pickwick Reservoir largemouth bass.

Table 2. Predicted fecundity of largemouth bass at three lengths as calculated from regression equations (Table derived from Timmons, et al. 1980).

Location	Total Length (mm)			Sample Size	Reference
	300	400	500		
Pickwick Reservoir	1,577	26,511	51,443	37	Present study
West Point Reservoir, Alabama-Georgia	13,266	32,412	72,658	73	Timmons, et al. (1980)
Belgrade Stream, Maine	15,803	23,993	86,745	20	Kelley (1962)
Lake Anna, Virginia	8,700	17,473	30,010	20	Wells (1976)
Center Hill Reservoir, Tennessee	8,871	22,273	45,487	20	Coomer (1976)

Production of Pickwick Reservoir largemouth bass fecundity from mean total lengths at annulus formation indicated the mean fecundity of bass at various ages (Table 3). Based on these predictions, sexual maturity is generally not reached until Age III in Pickwick Reservoir when the mean total length is 345 mm. The smallest sexually mature fish in the Pickwick Reservoir sample was 292 mm TL. This situation was substantially different from West Point Reservoir, a new impoundment where the largemouth bass grew quite fast and became sexually mature at Age I but were near 300 mm TL (Timmons, et al. 1980). In Belgrade Stream, Maine (Kelley 1962), largemouth bass have been observed to be sexually mature at Age III (294-300 mm TL). In all three locations, largemouth bass were near 300 mm TL but varied widely in age when sexual maturity was attained.

Table 3. Predicted fecundity of largemouth bass at various ages. Based upon mean calculated length at each age (Hubert 1975).

Age	Mean Total Length (mm)	Predicted Fecundity
III	286	0
IV	345	12,797
V	405	27,757
VI	457	40,722
VII	497	50,696
VIII	526	57,926

Fecundity of Largemouth Bass

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MIMICRY AND SPATIAL OCCUPATION IN THE
MYDAS FLY, *MYDAS CLAVATUS*¹

William E. Cooper, Jr.
Department of Biology
Auburn University at Montgomery
Montgomery, AL 36193

Despite its wide geographic range in the eastern United States and spectacular appearance, the mydas fly, *Mydas clavatus* (Drury) has received very little non-taxonomic attention. Larval mydids are associated with rotting logs, stumps, and soil, in which several species are predators of larval coleopterans (Clausen, 1940). Maggots of *M. maculiventris* feed on scarabaeid larvae in soil (Genung, 1959), but larvae of other North American species are known only from decaying wood. Maggots of *M. clavatus* have been discovered repeatedly in rotting tree stumps (Teskey, 1976). Adult mydids are also considered predaceous on insects (Genung, 1959). A final observation of importance to the present study is that adults of several mydid species have long been known as mimics of wasps (Howard, 1903). This report discusses mimicry and spatial occupation by *M. clavatus*.

Mydas clavatus was observed in Montgomery County, Alabama, during summer 1979, in an open area at the edges of a pecan grove, a cow pasture, and a deciduous forest. The site was exposed to full sunlight throughout much of the day and contained numerous broad-leaved weeds which served as the primary perches. Observations of behavior and spatial occupation were recorded during the entire adult seasonal activity period which extended from June 22 to August 3 at this site. The site was surveyed an average of twice per day.

MIMIC AND MODEL: ANATOMY AND COLOR

Mydas clavatus (Diptera, Mydidae) is a large black fly with an elongate body measuring about 25 to 38 mm to the tips of its folded wings (Smith *et al.*, 1962), which lie along the anteroposterior axis. An orange band covers the dorsal and lateral aspects of the second abdominal segment, and is clearly visible during flight. Although obscured dorsally by the folded wings in a perching fly, the orange band remains noticeable laterally. This small area of bright color stands out against its dark background enough to be one of the first features noted by naive observers.

Spider wasps (Pompilidae) similarly are elongate. Most species have plain black coloration, but many are black with orange-red markings,

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a trait shared with numerous ground-dwelling wasps (Evans and Eberhard, 1970). *Mydas clavatus* bears a close morphological resemblance to the pompilid *Anoplius marginalis* (Banks) of eastern North America. *Anoplius marginalis* is black with an orange band in the anterior abdominal region. Unlike the band of *M. clavatus*, which is restricted to the second abdominal segment, that of *A. marginalis* includes the three anterior segments (Borror and White, 1970). Despite this wider distribution of orange in *A. marginalis*, very little difference in appearance from *M. clavatus* results because the orange is usually less concentrated in segments one and three than in segment two and because the orange coloration extends laterally primarily in the second segment, where it is also visible in the mydid. However, the orange color sometimes appears equally intense on segments one and two. The morphological similarity to spider wasps is enhanced by long metathoracic legs, antennae which are exceptionally large for a dipteran yet approach those of *A. marginalis* in relative proportions, and by expanded single wings which approximate the combined width of the hymenopteran's paired wings.

One discrepancy between mimic and model is the relatively small size of the latter, which is only about 20 mm long. Possible explanations for the larger size of *M. clavatus* include nonspecificity of mimicry, fear engendered in potential predators by a supernormal stimulus, necessity for effectiveness in its predaceous mode of life, and evolutionary transition from a larger model at a previous time or in other parts of its range. These hypotheses are neither exhaustive nor mutually exclusive, but do represent plausible reasons for observed length differences. First, the wasp-like appearance of *M. clavatus* seems sufficiently convincing to deter predators capable of even rudimentary stimulus generalization, especially as this generalization is reinforced by widespread Mullerian mimicry among wasps. If so, there may be no direct dependence of the appearance of *M. clavatus* on that of *A. marginalis*, or only a partial dependence. A second interpretation is that although *A. marginalis* is a true and specific model, the greater size of *M. clavatus* provides additional antipredatory benefit by eliciting increased fear from potential predators. Mimetic supernormal releasers have been documented in avian brood parasitic systems. In some nestling parasites such as cuckoos and cowbirds (Hamilton and Orians, 1965; Welty, 1963) the parasitic nestlings, which are larger and more demanding of food than those of the host species, serve as supernormal releasers for feeding behavior by the parents. An exceptionally large wasp mimic might similarly evoke avoidance responses with enhanced reliability. Another possibility is that large body size is required for *M. clavatus* to overcome its prey. Since the predatory behavior of the adult fly, the prey size, and prey species are unknown, the importance of body size to predatory efficiency cannot now be evaluated. However, closely related asilid flies capture large prey. Finally, the large size of *M. clavatus* relative to its supposed model, *A. marginalis*, could be due to historical changes in which *M. clavatus* evolved as a mimic of a pompilid species larger than *A. marginalis*. Extant pompilids such as the tarantula hawks (*Pepsis*) reach lengths of 40 mm in the southwestern United States. Since these wasps are aposematically colored with blue-black bodies and orange wings and in addition possess violent stings, they make excellent models.

Several other pompilid genera (including *Hemipepsis*) contain species which are Mullerian mimics of *Pepsis*. The southwestern subspecies of some of the Mullerian mimics have orange-winged subspecies in the southwest but black-winged ones in the eastern states. Furthermore, several large mydid species are Batesian mimics of *Pepsis*, possessing blue-black bodies, orange wings, and a very similar pattern of flight (Evans and Eberhard, 1970). Thus, it seems possible that the large size of *M. clavatus* is derived from a mimic of *Pepsis*.

MIMETIC BEHAVIOR

In addition to its numerous pompilid-like anatomical features, *M. clavatus* has evolved marked behavioral mimicry of the spider wasps. When flying, this mydas fly so closely resembles a very large wasp that only an experienced observer would fail to regard it as such. Individuals observed in Alabama and Georgia normally fly much more slowly than common species of the related family, Asilidae, appearing at times almost to hover. Their large, beating wings produce a marked blur. During this leisurely flight, the long metathoracic legs are trailed behind the abdomen in the manner of many wasps (Cooper, personal observations). Combined with its large size and seemingly aposematic coloration, this flight pattern undoubtedly serves as an effective deterrent against many visually oriented predators.

Mydas clavatus perches almost exclusively in exposed, sunny spots, but at extremely high ambient temperatures may perch in shaded sites. In hundreds of observations, only once was a mydas fly seen to land in a thoroughly shaded site. This occurred in the early afternoon at an air temperature of 34.2° C (recorded 1 m above ground). No mydas flies were observed on heavily overcast days. On most occasions, perches chosen were the upper sides of the highest broad leaves on weeds from .3 to .7 m tall.

When *M. clavatus* lands, it may immediately fold its wings over the abdomen, but often holds them outstretched briefly before doing so. Holding the wings at right angles to the longitudinal axis in a frontal plane may represent an imperfect, incipient mimicry of pompilid behavior since spider wasps do not fold their wings longitudinally while at rest (Borror and White, 1970). The large antennae may also be waved, which enhances their wasplike appearance by combining it with wasplike motion. Just after landing, *M. clavatus* may arch its abdomen in the middle and, pointing the tip down, make repeated stinging movements. These are accurate copies of stinging behavior, visually indistinguishable from those of true stinging insects, but removed from normal context.

The mydas fly's repertoire also includes demonstrations of apparent indifference to potential predators. A mydas in flight approached slowly by a human observer often flies directly toward the person, veering away at close range and sometimes circling. This behavior can be disconcerting to an uninitiated observer, who may be quite convinced he is about to be stung by a huge wasp. On its exposed perches, *M. clavatus* is reluctant to flee, making possible capture by hand and close observation. If oriented toward the observer, mydas flies sometimes raise

one prothoracic leg and wave it up and down, evincing no tendency to flee. Although slow to flee, mydas flies will take flight when approached closely, but usually do not go far, landing within a few feet of their original perches. One fly was chased repeatedly to numerous perches. Time after time it flew only a few feet before landing, but eventually flew about fifty feet away and returned to land near its prior perch. After being disturbed many more times and flying to nearby perches, the fly repeated the longer flight twice, with short perch changes interposed between the two, then finally abandoned the area after 25 minutes of harassment.

Reluctance to flee and slow movement are well known traits of many aposematically colored species and their mimics. *Mydas clavatus* has thoroughly developed these traits and has apparently evolved the flying approach as an additional means of predator deterrence. However, the slow motions contrast with the active foraging of *A. marginalis*. This discrepancy suggests that *A. marginalis* may not be the specific model, in which case another pompilid species or generalized pompilid characteristics might serve in that role. Another possibility is that the slow movement confers a decreased likelihood of predation relative to the more rapid motion which would characterize an accurate behavioral mimic.

Venomous hymenopterans participate in sometimes large complexes of Mullerian mimics (Rettenmeyer, 1970), frequently serve as models for Batesian mimics, and have been proposed as targets of aggressive mimicry. The latter two types of mimicry have been studied for dipteran mimics of wasps and bees. Numerous examples of Batesian mimicry are noted by Cott (1957) and Wickler (1968). Of particular interest is mimicry of a long-legged digger wasp from Borneo, *Macromeris violacea*, by a fly of the genus *Mydas* whose spread wings are nearly as large as the combined forewings and hindwings of the model as in *M. calvatus*. In addition *Mydas* has an elongated body form more typical of wasps than flies.

Mydas clavatus is in all probability a Batesian mimic, but may possibly benefit as a predator by its wasp-like appearance. Although many flies attack wasps, only assassin flies (Asilidae) are known to prey on adult wasps (Evans and Eberhard, 1970). Several mydids are large enough to attack adult wasps and are considered predatory. In the present study one mydas fly was observed to attack and chase a large black wasp which flew over the fly's perch, but no feeding or successful predatory attack was observed. The single attack could have represented not predation, but misdirected territorial behavior.

Even if *M. clavatus* is found to prey on spider wasps, especially *A. marginalis*, previous studies of hymenopteran-dipteran mimetic systems point to probable unimportance of an aggressive component in the appearance of *M. clavatus*. A well-known case of suspected aggressive mimicry of a hymenopteran by a dipteran involves the asilid fly, *Mallophora bombooides*, and its bumblebee model, *Bombus americanorum*. The assassin fly was found to resemble the bumblebee's coloration, color pattern, and its sound in flight. Furthermore, it attacked and killed many bumblebees. However, Brower, Brower, and Westcott (1960), noting that

M. bombooides consumes many insects besides bumblebees, felt that the mimicry was probably Batesian, even though secondarily beneficial for predation on *B. americanorum*. Some other asilids which appear wasp-like, having slender elongate bodies and sometimes transverse bands of color, have been considered probable aggressive mimics, but usually prey on a variety of hymenopterans without closely mimicking the appearance of prey species. Since asilids live in proximity to many species of wasps and are treated as wasps by birds and other insectivorous vertebrates, they probably are Batesian mimics (Evans and Eberhard, 1970). The above conclusions regarding mimicry by asilids have spread through the literature, but do not seem completely warranted. On the contrary, it is quite reasonable to expect selection pressures favoring avoidance of predators and allowing close approach to prey to be simultaneously operational. Predatory or parasitic species could incorporate a mixed Batesian-aggressive mimicry. In asilids, frequent reliance on rapidly overtaking prey in flight suggests the relative unimportance of the predator's appearance to evasive behavior by prey species. Thus, although aggressive benefit may occur in *M. clavatus*, it is not likely to be an important selective force, whereas avoidance of predators in the Batesian manner assuredly is.

SPATIAL OCCUPATION

Occupation of home ranges and territories are extremely widespread forms of site specificity or site fidelity among vertebrate species. As more data are gathered it is becoming clear that many invertebrates share these features. Numerous cases of confirmed and probable territoriality have been reported in most of the major insect orders, notably in Odonata, Orthoptera, Isoptera, Hemiptera, Coleoptera, Lepidoptera, Hymenoptera, and Diptera. Examples from these orders are summarized by Price (1975).

No systematic capture-recapture observations were made to determine the precise spatiotemporal extents of areal occupation by *M. clavatus*, but low population densities and individual size variation allowed monitoring of individual movements over periods lasting several days, with repeated observations on many days at hourly intervals. Individuals typically occupied restricted areas for a few days, disappeared, and were replaced by others. One fly restricted its activities to a roughly triangular area with sides of 5.3, 12.1, and 13.3 m. Others had somewhat smaller L-shaped or U-shaped home ranges which followed the walls of an abandoned shack, and some occupied irregularly shaped areas. Within the home ranges, mydas flies spent much time perched on the upper surfaces of broad leaves fully exposed to direct sunlight. At intervals they made patrolling flights, at roughly 0.6 to 2.0 m altitude. On these flights the flies frequently traversed their entire home ranges. Their attachment to the home range is manifested by marked reluctance to leave the area. Mydas flies chased from their perches usually landed within a meter of their initial positions. One individual which was disturbed each time it landed initially made short moves between perches, longer flights when harassment was continued, then eventually quit the area. Similar behavior has been observed in numerous vertebrates, which are very difficult to drive out of their home ranges.

Since home ranges of adjacent individuals overlapped, patrolling flights sometimes brought one mydas near another perched individual. Almost invariably, the perched fly attacked the intruder in the air, engaged it in brief aerial maneuvers at close range, and chased it out of the home range before returning to the original perch or a nearby site. Such behavior, since it involves defense of an area and results in exclusion of conspecifics, constitutes territoriality. Alternative hypotheses are that the perched flies approach intruders for identification of potential mates or for predation. Although prey and mates might be identified during close maneuvers, the subsequent chasing cannot be explained by predatory or sexual motives unless all approached individuals were fleeing cannibalistic attacks or displaying sexual rejection. At no time was *M. clavatus* observed feeding or mating.

By far the most likely explanation of the chasing of intruding conspecifics by mydas flies is defense of territory. Chasing of conspecifics by fourteen syrphid species (subfamily Milesinae) was similarly interpreted by Maier and Waldbauer (1979), who noted that territorial male syrphids may attempt to mate with all nonresident conspecifics. Even if this were so, which the authors could not determine by valid visual observations, resident males would gain exclusive access to receptive females in the defended area, chasing only nonresident males and nonreceptive females.

Territorial residence may be favored by sexual selection when those males occupying territories have greater chances of mating. In hexapods, the most widespread type of territory is established and maintained by males which defend their areas against intrusion by conspecific males. Each resident thereby gains exclusive mating rights to females within its territory (Price, 1975). Such sexual selection may operate in *M. clavatus*, but no direct evidence is available.

Patterns of spatial occupation other than territoriality have received somewhat less attention from insect ecologists than has territoriality. This is especially true of residence in home range or site fidelity (but much effort has been devoted to studying orientation to nests and feeding sites). In contrast to a territory, the home range is not necessarily a defended area; rather, it is the area occupied by an animal during activities such as foraging, seeking refuge, breeding, etc. The preliminary observations recorded in this study establish that specimens of *M. clavatus* sometimes occupy restricted home ranges. Although the rough definition of home used here gives a simple, intuitive idea of what constitutes a home range, operational definitions used to measure the home range's extent should include a temporal component and precise spatial measurements. Home range measurements ideally should be given as areas or volumes occupied over a given interval of time (Cooper, 1978). Such data for *M. clavatus* are lacking.

Should *M. clavatus* be proven territorial, there may be an interesting connection between its territorial behavior and mimicry. Mimicry, through its reduction of effective predation pressure, may have made possible the evolution of territoriality in *M. clavatus*. Since the selective value of territoriality is diminished by increased exposure of

displaying or fighting territory holders to predation, any factor tending to reduce the probability of predation should increase the net selective benefit of territoriality. Batesian mimicry, which evolves as an antipredatory adaptation, should therefore facilitate evolution of territoriality.

SUMMARY

Batesian mimicry of pompilid wasps by *M. clavatus* is expressed in numerous anatomical and behavioral features. Although *A. marginalis* is the probable model which bears a striking resemblance to *M. clavatus*, the mydas fly could have evolved similar features based on a polyspecific complex of pompilid models. *Mydas clavatus* definitely occupies home ranges and is very likely territorial. However, confirmation of territoriality will require more detailed behavioral observations. Territoriality, unknown among other flies in suborder Asiloidea, is highly probable in *M. clavatus*, which makes patrolling flights of its home range and chases nonresident conspecifics.

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PREDATION BY THE RED IMPORTED FIRE ANT, *SOLENOPSIS INVICTA*
(HYMENOPTERA: FORMICIDAE), ON EGGS OF THE LIZARD
CNEMIDOPHORUS SEXLINEATUS (SQUAMATA: TEIIDAE)¹

Robert H. Mount, Stanley E. Trauth², and William H. Mason
Department of Zoology-Entomology
School of Agriculture and Agricultural Experiment Station
Auburn University, AL 36849

Abstract. Results of field experiments conducted in eastern Alabama in 1977 and 1978 strongly suggest that the red imported fire ant, *Solenopsis invicta*, will attack and consume eggs of the lizard *Cnemidophorus sexlineatus*.

INTRODUCTION

Reported herein are the results of field experiments on predation by the red imported fire ant, *Solenopsis invicta* Buren, on the eggs of the six-lined racerunner, *Cnemidophorus sexlineatus*. The study was prompted by concern that the ant is adversely affecting many reptiles and several other vertebrates in the infested area, an area which now extends from the Carolinas to central Texas. Evidence warranting such concern is presented in the following companion paper by the senior author (Mount 1981).

The eggs of *C. sexlineatus* were used in the study because they are easy to obtain. The lizard is a ground-dweller that inhabits relatively open, well-drained habitats of the type that often support substantial fire ant populations. The eggs have parchment-like shells and are deposited in chambers at the ends of burrows constructed by the females. Following oviposition, the nests are abandoned.

EXPERIMENT 1

Methods and Procedures

This experiment, conducted during the summer of 1977, involved placing eggs of the lizard *Cnemidophorus sexlineatus* in simulated nests in a field in eastern Alabama infested with *Solenopsis invicta*, and observing them periodically for evidence of possible fire ant predation.

¹Manuscript received 23 February 1981; accepted 31 March 1981.

²Present address: Department of Biology, Georgia Southwestern College, Americus, GA 31709.

Predation by the Red Imported Fire Ant

Located in the Piedmont in Chambers County, 5.2 km north of Gold Hill, the 3-ha field had been in cultivation the previous year. It was covered with weeds at the time of the experiment. The soil is a gravelly clay-loam. The fire ant colonies were young and could be detected only by close scrutiny.

Six 30-m² plots, separated from each other by a 3-m buffer strip, were established in linear fashion in the field. A small mound of loosened soil was constructed in the center of each plot, and 5 simulated nest cavities were fashioned within each mound. The cavities were formed by inserting a finger to a 6-cm depth into the sides of the mound and making an enlargement at the end with the fingertip. Four or 5 eggs were introduced into each cavity. The eggs had been collected from natural nests and were in varying stages of development. A total of 122 eggs was deployed, 20 in each of 5 plots, and 22 in the 6th.

Clumps of soil were placed over the openings of the passages leading to the simulated nest chambers, and the mounds were covered with a shallow (1 cm) layer of loose soil. The mounds containing the simulated nests were protected from potential mammalian and reptilian predators by cylinders of 1/8-in mesh hardware cloth 30 cm in diameter.

An attempt was made to destroy the ant colonies in the 1st, 3rd and 5th plots with kerosene, but we were able to locate relatively few of the colonies because of the dense vegetation cover, and all plots remained infested.

Results

The plots were visited after 2 days. At this time fire ants were seen crawling over the mounds and, in some cases, appeared to be entering and leaving the artificial nests. On the 14th day, all nests were examined and opened for inspection. Although there was no overt evidence of the nests' having been disturbed, only 2 contained intact eggs (2 in 1 nest and 1 in the other). Both of these nests were in the same plot. Shell fragments were found in several nests; however, in the majority no traces of the eggs remained. There was no evidence that any eggs had hatched. It was suspected, though not confirmed by direct observation, that fire ants were responsible for the apparent predation.

EXPERIMENT 2

Methods and Procedures

This experiment was designed specifically to test the hypothesis that the fire ant *S. invicta* would consume eggs of *C. sexlineatus* in simulated nests constructed in the vicinity of their colonies. The test was conducted during the summer of 1978 in a weedy field in the Piedmont of eastern Alabama, 5.5 km south of Salem, Lee County. Four groups of 5 nests each were constructed in a manner similar to that used in Experiment 1. Two groups were situated 2 m apart, 3 m from an active fire ant colony, and the other 2 were similarly situated with respect to another ant colony and to each other. One of each in the 2 groups was provided

with a hardware cloth enclosure to protect it from large predators, and the other was enclosed within a circular shield of galvanized metal to protect it from ants and other such small predators, as well as from large predators. The lower rim of the metal shield was sunk 15 cm into the soil and a small amount of kerosene was poured around its periphery to inhibit entry of potential predators from beneath. A mixture of petroleum jelly and insect repellent was smeared in a band on the outer surface just below the upper rim to inhibit insect predators from gaining entry by crawling over.

Each of the 5 simulated nests within each of the 4 groups was provided with 3 eggs of *C. sexlineatus*. The eggs had been collected from natural nests 3 days earlier and were in varying stages of development. They had been soaked the previous night for 15 hours in 10 ml of an aqueous solution containing 60 μCi of the radionuclide ^{32}P . This treatment resulted in the eggs' absorbing 45 μCi of the ^{32}P (an average of 0.75 $\mu\text{Ci}/\text{egg}$). The eggs were placed in the simulated nests and the entrances closed with small rocks. A shallow layer of loose soil was then spread over the surface of each nest mound.

Results

After 2 days, inspection revealed all the eggs within the metal-enclosed mounds to be in place and intact. None of the eggs remaining within the wire-enclosed mounds was intact, and in most nests, no traces of the eggs could be found.

Excavations were then made into the fire ant mounds, and surveys with a portable scintillation detector revealed detectable beta radiation from each. Material for laboratory sampling was collected from each ant mound by flotation. Soil from the mound, containing both adult and larval ants, was shoveled into a plastic pail partially filled with water. The ants, along with some detritus, floated on the surface, and were transferred to plastic bags and secured.

Laboratory analysis of the first sample, which included adult and larval ants from one mound, along with some detritus, contained 1.4×10^{-4} μCi per gram of sample. The second and third samples, consisting, respectively, of larval and adult ants from the other mounds, contained, respectively, 12.2×10^{-4} $\mu\text{Ci}/\text{gm}$ and 6.6×10^{-4} $\mu\text{Ci}/\text{gm}$. No estimate was made of total radioactivity contained within the mounds, but it certainly amounted to a substantial amount (probably in the range of 10-20%) of the initial label.

The nests enclosed by the metal cylinders were opened on the 16th day of the experiment. The eggs showed no evidence of predation or attempts at predation.

DISCUSSION

The obvious question to address at this point is how a significant amount of the radioactive phosphorus was transferred from the reptile eggs to the fire ant nest in a 48-hour period. We assume that the eggs

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must have been eaten, since no visible remains of shells or embryos were evident in either the lizard or ant nests. Previous research on the characteristics of radionuclide cycling in invertebrates provides some useful clues. It has been found in beetles and roaches (Burnett et al. 1969), isopods (Lauhachinda and Mason 1979), and crickets (Grant et al. 1980) that 50 to 90% of ingested radionuclides are voided during the following 48-hour period. If the ants ingested the majority of the original label, either in the artificial lizard nests or in their own nests, most of that label would have been passed in their feces by the time we collected laboratory samples for radionuclide analysis. The collecting technique would have excluded fecal residues unless they had clung to organic debris. The levels of radionuclides found in the larvae and adults suggest that all the original label could have been ingested by the ants.

There remains one other explanation as to how the ^{32}P could have gotten into the fire ants (nests). Conceivably the lizard eggs could have been eaten initially by a predator that was subsequently killed and eaten by the fire ants. Our previous research on the transfer of radionuclides within food chains suggests that in this case we would probably not have found enough of the phosphorus to even measure. In other words, by the time the ^{32}P had passed through two digestive tracts, the small amount remaining in the ants' bodies would have been indistinguishable from background.

The results of these experiments strongly suggest that the red imported fire ant, *Solenopsis invicta*, will attack and consume eggs of the lizard *Cnemidophorus sexlineatus* in artificially prepared nests in the field. The evidence reported is admittedly circumstantial, and the experiments are of preliminary design. A sensitivity to the disturbed soil or to the chemicals associated with human skin, or to both, may have attracted the ants to the nests, but such would not negate the implied hypothesis. The data collected in these tests clearly indicate the need for a more detailed study involving this and other possible native prey species.

ACKNOWLEDGMENTS

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THE RED IMPORTED FIRE ANT, *SOLENOPSIS INVICTA* (HYMENOPTERA: FORMICIDAE), AS A POSSIBLE SERIOUS PREDATOR ON SOME NATIVE SOUTHEASTERN VERTEBRATES: DIRECT OBSERVATIONS AND SUBJECTIVE IMPRESSIONS¹

Robert H. Mount

Department of Zoology-Entomology
School of Agriculture and Agricultural Experiment Station
Auburn University, AL 36849

Abstract. The imported fire ant *Solenopsis invicta* may well constitute a serious threat to certain ground-dwelling reptiles and birds in heavily infested areas. Supportive evidence consisting of direct observations of ant predation is presented, along with subjective impressions of trends in densities of Alabama Coastal Plain populations of several reptiles and birds.

INTRODUCTION

Imported fire ants, *Solenopsis richteri* Forel and *S. invicta* Buren,² continue to occupy the attention of a substantial number of agriculturally oriented researchers. The ants' adverse impacts on agriculture in the Southeast are fairly well known. The life histories and habits have been studied in some detail, and data are accumulating relative to the ants' interactions with other insects in the infested area. Surprisingly little is known, however, of the effects of these alien predators on native vertebrate animals.

Johnson (1962) reported that imported fire ants will, under certain circumstances, kill and eat Bobwhite Quail chicks at the time of hatching, but found no convincing evidence that the ants were causing substantial declines in Quail populations. The young of Bobwhites are precocial, however, and Johnson recognized the need for research on fire ant predation on species such as Meadowlarks and cottontail rabbits, whose young are naked and helpless at the time of hatching or birth.

Hill (1969), in a study of penned cottontail rabbits, concluded that imported fire ants were responsible for heavy mortality on nestlings. He

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²*Solenopsis invicta*, the most recent arrival of the two imported fire ants, is now the dominant form, having replaced *S. richteri* in all but a small area in northeastern Mississippi and northwestern Alabama. The habits of the two species are apparently similar (see Hung et al. 1977).

stated, however, that "this is not meant to imply that fire ant predation could seriously alter cottontail populations in an unrestricted natural environment" infested with fire ants.

I am aware of no studies or published reports dealing with imported fire ant predation on reptiles or amphibians, although I have speculated that reptiles and amphibians in Alabama may be adversely affected by the ants (Mount 1976). A suspicion on my part that the ants may be responsible for apparent declines in several Alabama vertebrates prompted a study of fire ant predation on eggs of the lizard *Cnemidophorus sexlineatus* in 1977 and 1978, the results of which are presented in the preceding companion paper (Mount et al. 1981). The results of the study indicated that eggs in simulated nests in a field infested by *S. invicta* were readily attacked and consumed by the ants. Meanwhile, additional evidence of fire ant predation on eggs and young of reptiles continues to accumulate, along with indications that several bird species are being adversely affected by the ants.

The purpose of this paper is to present accumulated evidence of fire ant predation and to bring to the attention of naturalists and other interested parties a situation that I believe to be a serious threat to several components of the southeastern fauna.

OBSERVATIONS OF FIRE ANT PREDATION ON EGGS AND YOUNG OF REPTILES

In 1975, I unearthed a clutch of freshly deposited eggs of a soft-shell turtle (*Trionyx* sp.) on a sandbar along the Alabama River in Wilcox County, Alabama, and noted numerous fire ants within the nest chamber. The eggs were undamaged. The eggs of *Trionyx* are hard-shelled and in this respect differ from all but a few of the other oviparous southeastern reptiles. Whether the ants had located the nest as the result of a chemical or physical cue or had found it during random foraging activity is not known, but it strongly appeared that the nest and/or the egg complement constituted an attractant.

During the same year, Dr. Keith Causey, of Auburn University, related to me an observation of imported fire ants raiding the nest of a chicken turtle, *Deirochelys reticularia*, in southern Georgia. The ants were crawling about on the surface above the nest and were abundant within the nest chamber itself. Causey related that the nest contained "several" dead baby turtles and one that was still alive. He surmised that the deaths occurred as a result of the ants' stinging.

In a study of reproduction in the gopher tortoise (*Gopherus polyphemus*) in southern Georgia, Landers et al. (1980) reported fire ants destroying 10 hatchlings (included within 3 separate nests). In addition, Landers provided me with field notes he had made involving other instances, and apparent instances, of fire ant predation on reptiles:

1. One hatchling *Terrapene carolina* was found covered with fire ants. It was alive, but died within a few days.

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2. One second-year *Graptemys barbouri* was found covered with fire ants. It died several days later.

3. Two eggs of *Anolis carolinensis* were found in a moist pile of leaves and sand. One had been perforated, apparently by fire ants, and was collapsed; the other was intact and contained an advanced embryo.

4. Three lizard eggs and fragments of others, probably those of *Cnemidophorus sexlineatus*, were found next to a racoon-ravaged nest of *Gopherus polyphemus*. Ants, apparently, had eaten into the lizard eggs.

HERPETOFAUNAL TRENDS IN ALABAMA

In 25 years of field work in portions of Georgia, Florida, Mississippi, and essentially the entire state of Alabama, I have seen numerous changes in the distribution and relative abundance of various components of the area's herpetofauna. Some of the changes in population densities have seemingly involved increases or decreases of relatively short-termed duration, while others have been long-termed and sustained.

In general, the most substantial changes have occurred since about 1968 among some lizard and snake populations inhabiting the Coastal Plain and adjacent portions of other provinces. Table 1 lists a number of snakes and lizards found in the Alabama Coastal Plain region and a comparison of their pre-1968 status to that at present. The indicated status in each case is my own impression based on personal observations and on conversations with other herpetologists and naturalists in Alabama. Forms occurring in the Alabama Coastal Plain that do not appear on the list are those with which my experience is too limited to enable me to form definite impressions.

The deteriorating status of some forms, such as *Gopherus polyphemus* and *Crotalus adamanteus*, is, I believe, attributable, in part at least, to heavy human predation. The declines of several other forms, however, are not easily explainable (see Mount 1975, pp. iii-iv; and Mount 1976). Habitat loss or modification is frequently cited as the single most important cause of declining Alabama species, but in the case of many of the declining reptiles, seemingly acceptable habitat is present in fair abundance. Pesticides may be contributing, either directly, or indirectly by decreasing food availability. It seems unlikely, however, that pesticides are playing the major role, because the declines occurring in areas of low pesticide usage are comparable to those where pesticide use is heavy. Moreover, most amphibians and aquatic snakes, along with several terrestrial snakes and lizards, are still present in substantial numbers.

I am of the opinion that predation by imported fire ants on eggs and newly hatched or newborn young is primarily responsible for the observed trends. Supporting evidence, though circumstantial, is, in my mind at least, substantial. In addition to the field test results reported in the preceding paper (this issue) and to the observations reported above, the following considerations support my hypothesis:

Table 1. Temporal comparison of the status of several species of snakes and lizards in the Alabama Coastal Plain.

Taxon	Status (See text)	
	Pre-1968	Present
Large ovipares		
<i>Coluber constrictor</i>	Abundant	Locally common
<i>Elaphe guttata</i>	Generally common	Locally common
<i>Elaphe obsoleta</i>	Abundant	Common
<i>Lampropeltis getulus</i>	Common	Uncommon
<i>Pituophis melanoleucas mugitus</i>	Locally common	Scarce
Small to medium-sized ovipares		
<i>Anolis carolinensis</i>	Abundant	Common
<i>Cemophora coccinea</i>	Generally common	Locally common
<i>Cnemidophorus sexlineatus</i>	Abundant	Locally common
<i>Diadophis punctatus</i>	Abundant	Common
<i>Eumeces fasciatus</i>	Abundant	Common
<i>Eumeces inexpectatus</i>	Locally abundant	Infrequent
<i>Eumeces laticeps</i>	Moderately common	Common-abundant
<i>Heterodon platyrhinos</i>	Common	Infrequent
<i>Heterodon simus</i>	Scarce	Exceedingly scarce
<i>Lampropeltis calligaster</i>	Scarce	Exceedingly scarce
<i>Lampropeltis triangulum</i>	Locally common	Uncommon
<i>Leiopeltis laterale</i>	Abundant	Common
<i>Micrurus fulvius</i>	Infrequent	Infrequent
<i>Opheodrys aestivus</i>	Common	Infrequent
<i>Ophisaurus</i> spp.	Common	Infrequent
<i>Sceloporus undulatus</i>	Abundant	Common
<i>Tantilla coronata</i>	Abundant	Locally common
Large "vivipares"		
<i>Agkistrodon</i> spp.	Common	Common
<i>Crotalus adamentus</i>	Locally common	Infrequent
<i>Crotalus horridus</i>	Locally common	Locally common
<i>Nerodia</i> spp.	Common-abundant	Common-abundant
<i>Regina rigida</i>	Infrequent	Locally common
<i>Regina septemvittata</i>	Common	Moderately uncommon
<i>Sistrurus miliarius</i>	Infrequent	Infrequent
<i>Thamnophis</i> spp.	Common	Common
Small "vivipares"		
<i>Storeria</i> spp.	Common	Moderately uncommon
<i>Virginia striatula</i>	Abundant	Moderately common
<i>Virginia valeriae</i>	Abundant	Common

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1. The most dramatic changes in status have occurred in the Coastal Plain. The Coastal Plain of Alabama has the longest history of fire ant infestation, with most areas of the region having been invaded by 1958 (see Johnson 1962). It is logical to speculate that this region, along with portions of Mississippi and the Florida Panhandle, would be the first to experience the full impact of fire ant predation on components of the fauna (assuming that such predation is capable of causing a noticeable impact). In this connection it is noteworthy that fire ants apparently have difficulty establishing colonies in the excessively sandy soils of the central Florida Panhandle that support sand pine-rosemary scrub associations. It might be expected that in such habitats, the impact would be less severe than in those capable of supporting dense populations of the ants; I have observed this to be the case.

2. Reptiles within the group consisting of aquatic livebearers and relatively large terrestrial livebearers (with one exception, *Crotalus adamanteus*) have shown little indication of substantial, overall population declines in the Alabama Coastal Plain. It is logical to assume that these species would be more resistant to fire ant predation than some of the others.

3. Of the terrestrial oviparous and small livebearing snakes, those declining most noticeably in the Alabama Coastal Plain tend to be inhabitants of relatively open, dry habitats of the type that are likely to support dense fire ant populations. Among these snakes are *Tantilla coronata*, *Virginia striatula*, *Pituophis melanoleucas*, *Heterodon simus*, *Elaphe guttata*, *Cemophora coccinea*, and *Masticophis flagellum*. On the other hand, *Elaphe obsoleta*, *Coluber constrictor*, *Virginia valeriae*, and *Heterodon platyrhinos*, which have shown only moderate declines, are often found in habitat types which are damp, or shady, or both, and in such places fire ant population densities are usually relatively low.

4. A striking change in species composition of samples of "five-lined skinks" collected in the Alabama Coastal Plain strongly suggests fire ant influence. During the 1960's *Eumeces fasciatus* predominated in a majority of samples taken in "general collecting" by me and my students. *Eumeces inexpectatus* was a frequent component of such samples, and *E. laticeps* was usually scarcest. Recently, *E. laticeps* has predominated in many, if not a majority of such samples, and now appears to be more abundant in the Alabama Coastal Plain than at any other time during my tenure in the state. The increase in numbers of juveniles is particularly noticeable. In showing an improved status, *E. laticeps* is almost alone among Alabama squamates, the only other being *Regina rigida*, in which the apparent increase in frequency of occurrence may be related to an increase in the number of borrow pits that result from highway construction. These pits, when they fill with water and become vegetated, are often optimal habitats for *R. rigida*.

Both *E. fasciatus* and *E. inexpectatus* have declined in frequency of occurrence, the latter especially so. A comparison of the habitats and nesting habits of the "five-lined skinks" in Alabama is perhaps elucidative. *Eumeces fasciatus* occurs in a wide variety of habitats, ranging from rather densely wooded, damp floodplains to relatively open sites

with well-drained soils. Mesic habitats support the greatest population densities. Nesting is usually on the ground under a rock or other sheltering object or in a rotting log or stump. Nests in logs and stumps are typically within 1 m of the ground. Both adults and young of *E. fasciatus* climb trees readily. *Eumeces inexpectatus* avoids mesic, densely wooded habitats and is most commonly encountered in relatively open forests and forest-field ecotones where the soils are well drained to excessively well drained. Nesting is typically close to the ground in logs or stumps. Adults climb readily, but juveniles seem reluctant to do so.

Eumeces laticeps, the largest of the three, is habitat-restricted only in its requirement of sizeable dead trees or tall stumps, or living trees with cavities, on a terrestrial site. Nests are typically located in trees or stumps well above the ground. Both adults and juveniles of *E. laticeps* climb readily and with considerably more facility than either of the other two "five-lined skinks."

The shifts in relative abundance of these three skinks may be ultimate responses to differences in susceptibility to fire ant predation. The habitats in which *E. inexpectatus* occur are those that are often heavily infested with fire ants. This, conjoined with its tendency to nest near the ground and a reluctance of the juveniles to climb, would seem to make *E. inexpectatus* a good candidate for fire ant predation. *Eumeces fasciatus* would be highly vulnerable in some habitats, less so in others. *Eumeces fasciatus*, with its arboreal inclinations, its tendency to exploit a wide variety of habitats, to nest well above the ground, and to attain a larger size, would seem to make it the least vulnerable of the three. Thus, the observed shifts correlate well with the apparent differences in susceptibility to fire ant predation and the resulting competitive advantage that *E. laticeps* would gain over the others.

DECLINES IN SOME GROUND-NESTING BIRDS

Paralleling the declines of certain reptiles in the Alabama Coastal Plain have been declines in breeding populations of at least 2 ground-nesting birds, and possibly a third which frequently nests on the ground. The Nighthawk, until fairly recently a common summer resident in rural areas of the Coastal Plain, is not infrequently encountered during the breeding season. Typically, in rural areas, this bird nests on the ground in open areas likely to be infested by fire ants. It leaves its helpless young in early morning and late afternoon in search of food. At these times, fire ants are actively foraging. Nighthawks have not shown similar substantial declines in rural areas of northern Alabama where fire ants are absent (Dwight Cooley, pers. comm.).

The Ground Dove, once locally common in the Alabama Coastal Plain, is now infrequently encountered over most of the region and some populations may be completely extirpated. This diurnally active bird typically nests on the ground or close to the ground in dry, relatively open places, and its helpless hatchlings would seem to be highly vulnerable to fire ant predation.

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My observations indicate that Eastern Meadowlarks are considerably less common during the summer in the Alabama Coastal Plain than they were a decade or so ago, even in areas of suitable habitat. The young of this bird are altricial and the nests are situated on the ground in fields and pastures. In northern Alabama, breeding Meadowlarks are still present in substantial numbers in their usual haunts (Dwight Cooley, pers. comm.).

I suggest that the apparent declines in these three birds are real, and that fire ant predation is a major causative factor.

CONCLUSIONS

If the imported fire ant is responsible for the trends in Alabama discussed above, similar ones should ultimately occur in other heavily infested areas, and in those destined to become heavily infested. According to my observations, a lapse of between 10 and 20 years is to be expected between the time an area becomes heavily infested and the time the impacts become obvious to the field naturalist. The area currently infested extends from the Carolinas to central Texas. The spread into the interior provinces seems to have slowed measurably within the past decade, and the limits of the area within which the ants can develop high population densities may have been reached.

Meanwhile, interested present and future workers within infested areas should be watchful for direct as well as indirect evidence of fire ant predation on potentially vulnerable native animals. Indirect evidence would include changes in reproductive strategies, habitat preferences, or other aspects of the animals' life history or ecology that would enable them to cope with fire ant predation more effectively. Some effort is being made to learn more of the biology of fire ants with a view toward developing ecologically sound control measures. This effort is, in my opinion, warranted and deserves the support of concerned naturalists.

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CONSTITUTION AND BY-LAWS OF THE ALABAMA ACADEMY OF SCIENCE
(as amended October 11, 1980)

STATE OF ALABAMA)
: ss.
JEFFERSON COUNTY)

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned constituting the trustees of Alabama Academy of Science, an association heretofore unincorporated, desiring to become incorporated under the provisions of Title 10 of the 1940 Code of Alabama, do hereby file this declaration in writing, and state:

ARTICLE I--NAME

The name of this corporation shall be Alabama Academy of Science.

ARTICLE II--OBJECTS

The objects for which the corporation is formed are:

1. To promote the development of interest in scientific matters in the State of Alabama;
2. To provide means for publication of scientific papers and abstracts;
3. To provide opportunity for increased cooperation and fellowship among its members;
4. To cooperate with other organizations having similar aims;
5. To render public service in scientific matters;
6. To promote the interest in and study of science by the youths of Alabama;
7. To provide for and award scholarships to deserving youths in Alabama;
8. The Alabama Academy of Science shall not have any capital stock, shall not pursue any of its objects or purposes for pecuniary profit to any of its members, and no part of its net receipts shall insure to the benefit of any private shareholder or individual.

ARTICLE III--LOCATION

The office of the Academy shall be in Birmingham, Jefferson County, Alabama.

Constitution and By-Laws

ARTICLE IV--POWERS

In furtherance, but not in limitation, of the powers conferred by statute, the Academy shall have power:

1. To charge an initiation fee and membership dues to provide income sufficient to meet the needs of its activities;
2. To acquire and hold real property and personal property, stocks in business corporations, bonds and other evidences of indebtedness, to receive property by gift, will, or device, and to hold the same in conformity with all lawful conditions imposed by the donor; to sell, lease or otherwise alienate its property and to exercise such other powers as are incident to private corporations, but not for the pecuniary gain of any member.
3. To borrow money and to secure the payment thereof by mortgage or deed of trust on all or any part of its property, real or personal or both;
4. To apply for, obtain, register, purchase, lease or otherwise to acquire, and to hold, use, own, operate and introduce, and sell, assign, or otherwise to dispose of, any trademarks, trade names, patents, inventions, improvements and processes used in connection with or secured under letters patent of the United States, or elsewhere; and to use, exercise, develop, grant licenses in respect of or otherwise turn to account any such trade-marks, patents, licenses, processes and the like, or any property or rights.

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The names, post office addresses, and terms of office of the founding trustees, as of 1947, are as follows:

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Constitution and By-Laws

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N. F. Anderton	Vulcan Materials Co., Birmingham	1983
James F. Sulzby	3121 Carlisle Road, Birmingham	1983

ARTICLE VI--MEMBERS

1. All members of the Alabama Academy of Science in good standing shall become members of the Corporation, and different classes of membership together with the rights and privileges of each class shall be determined by the By-Laws of the Corporation.

2. There shall be no personal, individual or other liability whatsoever on the part of any member of the Academy, either for the debts of the Academy or for any act or omission of the Academy or of any officer, agent or employee thereof.

ARTICLE VII--MEETING OF THE MEMBERSHIP

1. There shall be an annual meeting of the members of the Academy, the time and place to be determined by the Executive Committee at least twenty days in advance;

2. Special meetings of the membership may be called by the President and he shall call such meetings on the written request of ten (10) active members;

3. Notice of all meetings of the members shall be in writing mailed to the last known address at least ten (10) days in advance of such meeting. The members present at any such meeting shall constitute a quorum for the transaction of business;

4. The rights of members to vote at meetings of the membership shall be determined by the By-Laws.

ARTICLE VIII--OFFICERS

1. The officers of the Academy shall be elected by the membership and shall be twelve trustees, a president, a first vice-president (president-elect), a second vice-president, chairmen for the various sections, vice-chairmen for the various sections, a secretary, a treasurer, a councilor of the American Association for the Advancement of Science, an editor of the Journal, three counselors of the Junior Academy, and a Coordinator of Regional Science Fairs.

2. At the close of each annual meeting, the first vice-president (president-elect) shall become President of the Academy. A new first vice-president (president-elect), a second vice-president, and other officers to fill all other offices becoming vacant following the current annual meeting shall be elected by a plurality of the votes of the members present at said meeting and their terms of office shall begin at the close of the meeting.

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3. The tenure of office shall be one year or until successors shall be elected, except that the section chairmen and vice-chairmen shall serve two years and the trustees, the secretary, the treasurer, the councilor of the American Association for the Advancement of Science, the editor of the Journal, the Coordinator of Regional Science Fairs, and the three counselors of the Junior Academy, one of whom shall be elected each year to replace one whose term is expiring, shall serve three years and shall be elected triennially.

4. The affairs of the Academy shall be managed by an Executive Committee which shall be composed of the elected officers together with all active past Presidents and the Chairmen of standing committees authorized by the By-Laws.

5. The Executive Committee shall have the power to make and alter the By-Laws of the Academy; to hold meetings at such places and at such time as shall from time to time be designated by the By-Laws or by resolution of the committee; to fix the amount of fees and dues to be collected from members and shall have such other powers, not inconsistent herewith as may be necessary to carry out the purposes of the Academy. The By-Laws may prescribe the number of members of the committee necessary to constitute a quorum which number may be less than a majority of the whole number of the members.

6. Vacancies on the Executive Committee that occur between annual meetings shall be filled in the following manner: If the office of President shall become vacant, the first vice-president (president-elect) shall become President. If the office of first vice-president (president-elect) shall become vacant, the office shall be filled by the second vice-president. Vacancies in any other offices of the Academy shall be filled by the Executive Committee convened on call of the President or, if necessary, by the Secretary.

7. At his earliest convenience, the President shall make the necessary appointments to the Nominating Committee. This committee shall consist of six (6) members appointed for two (2) year terms, with three members going on and three going off each year. The president shall also appoint a chairman for the ensuing year. This committee shall be responsible for determining which elective offices are to be vacated and carrying on appropriate consultation regarding qualified nominees. The nominees shall be presented to the Academy meeting as a whole.

8. The Trustees shall be ex-officio members of the committee on finance for the Academy and shall take and hold title to all real property of the Corporation and shall act as custodians of all money and personal property of whatsoever kind except membership fees and dues, acquired by the Academy for purposes other than the general operating expenses thereof, in trust for the Academy, and shall disburse such money, dispose of such property, borrow money for such purposes other than the operating expenses of the Academy and make any issue notes, bills, bonds, and other evidences of indebtedness and convey by mortgage or deed of trust all or any part of the property owned, real or personal or both, by the Corporation, to secure the payment of any debts contracted by the authority of the Executive Committee; but before such

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mortgage or deed of trust can be executed, the majority of the Executive Committee shall have first authorized the incurring of the debt and the execution of such mortgage or deed of trust on all or part of the real or personal property, or both of the Corporation, which authorization must be made at a regular meeting or at a special meeting of the Executive Committee specifically called for the purpose. And the Executive Committee at any regular meeting, or at any special meeting called for that purpose, may grant authority to the Board of Trustees to convey by mortgage or deed of trust any or all of its property, real or personal, it may then own or thereafter acquire, for the purpose of securing any debts contracted by the Trustees for the Corporation.

9. The Trustees shall be elected to serve staggered terms of three (3) years unless specifically elected to serve a lesser term. They are eligible for reelection. The Board of Trustees shall meet immediately after the Annual Business Meeting to transact necessary business and to elect one of its members to serve as Chairman of the Board, either for the ensuing year or for the duration of his/her term as Trustee.

10. In case of any increases in the number of Trustees, the additional Trustees shall be elected as may be provided in the By-Laws and one-third of their number shall be elected to serve for one year, one-third for two years, and one-third for three years.

11. In case of any vacancy in the class of Trustee through death, resignation, disqualification or other cause, the Executive Committee, at any regular meeting, or any special meeting called for that purpose, by affirmative vote of the majority of the Committee present, may elect a successor to hold office for the unexpired term.

ARTICLE IX--DURATION

The duration of the Corporation shall be perpetual.

ARTICLE X--AMENDMENTS

This certificate may be amended at any annual meeting by a three-fourths vote of the attending members.

IN WITNESS WHEREOF, this certificate has been executed by the Trustees of the Corporation, acknowledged as required by Law, and offered for record in the Office of the Judge of Probate of Jefferson County, Alabama, this ____ day of _____, 1980.

Trustee

Address

Sworn and subscribed to before me this
____ day of _____, 1980.

SEAL

Notary Public

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Trustee

Address

Sworn and subscribed to before me this
____ day of _____, 1980.

SEAL

Notary Public

Trustee

Address

Sworn and subscribed to before me this
____ day of _____, 1980.

SEAL

Notary Public

Trustee

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Sworn and subscribed to before me this
____ day of _____, 1980.

SEAL

Notary Public

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BY-LAWS OF THE ALABAMA ACADEMY OF SCIENCE

ARTICLE I. MEMBERSHIP CLASSIFICATION

Sec. 1. The membership of the Academy shall consist of the following classes:

a) Member: Full membership in the Academy shall be open to any adult person in the state of Alabama and other states, who is actively engaged in teaching, research, or other professional activity in pure and applied science. Persons working in industry, economics, science education, and the social sciences shall also be eligible for full membership in the Academy.

b) Collegiate Member: Any person interested in the promotion of science in Alabama who is registered as a student in a college or university may qualify as a collegiate member for a maximum of five years.

c) Emeritus Member: Full members upon formal retirement and after at least twenty (20) years of active membership in the Alabama Academy or other state academy, may upon application to the secretary, have their status changed to Emeritus member with full voting and office holding privileges.

d) Honorary Member: Members of the Academy who have received outstanding recognition beyond the State of Alabama shall be eligible for honorary membership. Not more than two honorary members shall be elected in any one year.

e) Life Member: Any member of the Academy may become a life member by paying into the treasury at one time the amount established in Article II. (e).

f) Fellow: Members of the Academy who are Fellows of the American Association for the Advancement of Science shall be classed as Fellows of the Academy.

g) Complimentary Member: High school science clubs are classed as complimentary members. The counselor of the Junior Academy shall certify to the Secretary of the Academy by January 1 of each year those clubs entitled to such membership.

h) Sustaining Member: Any individual, corporation, or organization may become a sustaining member of the Academy. Each corporate or organization sustaining member is entitled to designate two individuals from its organization to represent it as active members in the proceedings of the Academy.

Sec. 2. Collegiate members shall not hold office nor vote. Members not residing in Alabama may not hold elective offices, but may serve on committees of the Academy.

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Sec. 3. The membership year and the fiscal year shall correspond to the calendar year.

a) New members joining October 1 or thereafter shall be new members as of January 1 the following year.

Sec. 4. Each nomination for membership must be endorsed by a dues-paid member who is in good standing in the Academy. Payment of the required dues and determination by the Secretary that the application meets the requirements for one of the classes of membership set out in Sec. 1. above shall constitute admission to membership.

ARTICLE II. DUES

Sec. 1. The dues for the several classes of membership shall be as follows:

a) Member: Ten Dollars (\$10.00) per annum.

b) Collegiate Member: Five Dollars (\$5.00) per annum.

c) Emeritus Member: Five Dollars (\$5.00) per annum.

d) Honorary Member: None.

e) Life Member: Two Hundred Dollars (\$200.00).

f) Fellow: Ten Dollars (\$10.00) per annum.

g) Complimentary Member: None.

h) Sustaining Member: Individual, Twenty-five Dollars (\$25.00) or more, per annum. Corporations and Organizations, One Hundred Dollars (\$100.00) or more, per annum.

Sec. 2. No one shall be eligible for office who is in arrears in the payment of dues.

Sec. 3. Members in arrears with their dues as of February 1 shall be dropped from membership.

ARTICLE III. SECTIONS

Sec. 1. The Academy shall have the following scientific sections:

- I. Biological Sciences
- II. Chemistry
- III. Geology
- IV. Forestry, Geography and Conservation
- V. Physics and Mathematics
- VI. Industry and Economics
- VII. Science Education

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- VIII. Social Sciences
- IX. Health Sciences
- X. Engineering
- XI. Anthropology

ARTICLE IV. COMMITTEES

Sec. 1. Standing committees of the Academy shall be set up as indicated below and serve for the terms and purposes stated.

a) Steering Committee: The Steering Committee shall consist of the President, Immediate Past President, First and Second Vice-Presidents, Secretary, and Treasurer. The Steering Committee is authorized to handle routine jobs of the Academy which shall arise between Executive Committee meetings. It is responsible to the Executive Committee and is not authorized to make decisions for the Academy.

b) Committee on Membership: This Committee consists of the Vice-Chairmen of the sections and a chairman appointed by the President-Elect. The chairman will serve a one-year term but may be reappointed to successive terms until he has served three years. The committee shall also include such other persons as the chairman deems necessary to provide. The committee shall, through its statewide membership, seek to secure new members, solicit contributing memberships, and handle such investigations and projects as may be assigned to it by the officers or committees of the Academy.

c) Committee on Research: The President-elect shall appoint one member to this committee of five (5) by the annual meeting and the President shall fill other vacancies as they occur. Terms shall be staggered and for five (5) years. The Chairman will serve a one-year term, but may be reappointed to successive terms until he has served three years. He must have served previously on this committee. The committee shall encourage scientific research in Alabama by whomsoever initiated and conducted, investigate possible sources of funds to be awarded by the Academy to research scientists, and make recommendations on the placing of such funds for the greatest benefit to science. The committee shall recommend any awards and the nature of each recognizing scientific accomplishments by high school students, college undergraduates, graduate students, and research scientists. Any funds awarded shall be expended directly for the purposes designated by a member of the Academy at the institution and/or department receiving the grant.

d) Committee on Long-range Planning: The Committee shall consist of four past presidents of the Academy, serving staggered terms of four years each, and shall be designated by the President-elect. The committee shall elect its chairman who shall serve a one-year term. The committee shall respond to any and all assignments referred to it by the President or the Executive Committee and shall make recommendations in the best interest of the Academy. The Committee may also originate recommendations to the Executive Committee on matters considered of significance to the Academy.

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- e) Auditing Committee: The President-Elect shall appoint annually two auditing committees of two members each, one for the Senior Academy and one for the Junior Academy. The committee shall examine and report to the Academy upon the financial records of the Treasurer of the Academy and the Treasurer of the Junior Academy, respectively, at the meeting for which they were appointed.
- f) Editorial Board: The Editorial Board shall consist of three members serving staggered terms of three years each, and the annual vacancy shall be filled by appointment by the President-elect. The Editor of the Journal is an additional ex-officio member of the Board. The Editorial Board shall concern itself with broad editorial policies and with problems of finance and shall act in a general advisory capacity to the Editor of the Journal. The Chairman of the Editorial Board, appointed for three years, shall be responsible for all matters pertaining to institutional subscriptions and exchanges for the Journal with the approval of the Executive Committee.
- g) Committee on Junior Academy: This committee shall consist of the counselors of the several regions, the state officers of the Junior Academy of Science, the sponsors of the state officers of the Junior Academy, and the three counselors elected by the Alabama Academy of Science. The duties of this committee shall be to coordinate the activity of the several regions of the Junior Academy in cooperation with the Coordinator of Regional Science Fairs, to promote the organization of chapters and by all possible means promote the welfare of the chapters, the regions and the entire Junior Academy.
- h) Committee on Place and Date of Meetings: The President-elect shall appoint one member to this committee of five (5) prior to taking office and the President shall fill other vacancies as they occur. Terms shall be staggered and for five (5) years. The chairman will serve a one-year term, but may be reappointed to successive terms until he has served three years, and must have served previously on the committee. The committee will make recommendations at the annual business meeting concerning the time and place for holding subsequent annual meetings.
- i) Committee on Local Arrangements: In consultation with the administration of the host institution, the President shall appoint a Local Arrangements Chairman. The Local Arrangements Chairman shall appoint subchairmen for the Senior and Junior arrangements and each subchairman will select the other members of his subcommittee. He is responsible for providing for the physical needs of the Academy at its annual meeting. He shall work closely with the President and the Secretary of the Academy as well as with his subchairmen.
- j) Committee on Newsletter: The President-elect shall appoint a Senior Editor At Large, for the state and ten (10) Associate Editors, one from each major institution in the state. The appointees shall constitute the Newsletter Committee and shall serve three (3) year terms. The major institutions shall be determined by inspection of the membership roster by institution. The Associate Editors shall supply the Senior Editor with items of interest and concern to the membership. The Newsletter

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shall also be the medium for conveying items of business from the officers to the membership. The Newsletter shall be published at regular intervals and forwarded to all members in good standing.

k) Committee on Public Relations: This committee shall be appointed by the President-elect. The Chairman shall serve a one-year term but may be reappointed until he has served three years. This committee shall seek adequate publicity for the meetings and work of the Academy.

l) Committee on Archives: The President-elect shall appoint a Chairman of the Committee on Archives who shall be the Archivist. The Archivist shall keep in a safe place the Archives of the Academy consisting of back numbers of the Journal, exchange publications, and records of the Academy.

m) Committee on Regional Science Fairs: This committee shall consist of the State Coordinator of Science Fairs and Regional Coordinators of the several regions. The committee shall coordinate the activities of the Regional Science Fairs in cooperation with the counselors of the Junior Academy of Science.

n) Committee on Science and Public Policy: This committee shall have a two-fold function: (1) To make scientific advice available to personnel at all levels of government in Alabama, and (2) to disseminate scientific information to the people of the State. The chairman shall be appointed by the President-elect for a one-year term, shall be eligible for reappointment, and shall be responsible for seeing that the committee functions.

o) Wright A. Gardner Award Committee: Shall consist of four (4) members appointed for two (2) year terms except the first year two shall be appointed for one (1) year terms and two (2) for two (2) year terms. Thereafter committee members shall serve two (2) year terms and the President shall appoint a chairman for the ensuing year. This award is made by the Alabama Academy of Science to some specific individual for noteworthy achievement in the field of Science during residence in Alabama. AAS members are invited to submit nominations for this award, made to the chairman of the Committee not later than October 1. Each nomination must be accompanied by a typed biography of the nominee and a citation which will be read at the time of the presentation at the Annual Banquet of the Senior and Junior Academies. The Committee, upon reaching a decision, to award or not award, must relay this information, privately, to the President of the Senior Academy not later than sixty (60) days before the annual Meeting. The citation shall be typed on Academy stationary, signed by the Chairman of the Awards Committee and the President of the Senior Academy, and neatly framed before delivery to the President or to the awardee.

ARTICLE V. DUTIES OF OFFICERS

Sec. 1. Trustees: The duties of the trustees are as enumerated in the Certificate of Incorporation. They shall have the right to hold meetings, both regular and special, at such time and

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places as may be convenient; and at such meetings a majority of the trustees shall constitute a quorum for the transaction of any business which may come before them.

a) All funds of the Academy which may come into the custody of the trustees shall be carried in a separate bank account in the name of the Academy. The trustees may designate one or more of their number to sign checks drawn to such account.

Sec. 2. Executive Committee: The duties of the Executive Committee are set forth in the Constitution.

a) The Executive Committee shall meet at least twice annually. One meeting shall be called by the President in the Fall. One meeting shall be immediately before the annual meeting of the Academy. The Executive Committee shall consider at these meetings such business as may properly be brought before it and shall make recommendations for action by the business sessions of the entire Academy.

b) Special meetings of the Executive Committee may be held whenever called by a majority of the members thereof, or by the President. Timely notice of a meeting, stating the time and place thereof and indicating briefly the objective thereof shall be given the members of the committee by mail, by publication, or by other suitable means whereby the notice may be conveyed. At all meetings of the Executive Committee, regular or special, the members present shall constitute a quorum for the transaction of any business which may come before it.

Sec. 3. President: The President shall preside at the sessions of the Academy as a whole, and of the Executive Committee.

a) The President shall appoint members to fill vacancies on all committees except as otherwise herein provided.

b) The President shall obtain an appropriate speaker to address the annual banquet. He will share this responsibility with the Counselor of the Junior Academy in alternate years, with the approval of an invitation to the speaker coming from the President of the Academy.

c) The President and Secretary shall make a site visit to the host institution to evaluate facilities for the annual meeting with the Local Arrangements Chairman at least 30 days prior to the Fall meeting of the Executive Committee. A report shall be made at this meeting.

Sec. 4. First Vice-President (President-elect): During his tenure the First Vice-President shall select chairmen and members to all committees provided herein. They shall be appointed and begin their tenure when he becomes President.

a) He shall become acquainted with the duties and problems of the Secretary through personal visits and other contacts.

b) He shall work with the Public Relations Chairman and the Newsletter Chairman in informing the public and the Academy members of the program

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and activities of the Alabama Academy of Science, its officers, and members.

c) He shall perform any other duties delegated by the President.

d) In the absence of the President, he shall chair all meetings.

Sec. 5. Second Vice-President: During his tenure, he shall review the financial and publication operations of the Academy.

a) The Second Vice-President shall work with the Committee on Membership and others in building up membership in the sections and the Academy.

b) He shall become acquainted with the duties and problems of the Treasurer and the Journal Editor through personal visits and other contacts.

Sec. 6. Section Chairmen: Each chairman in cooperation with the vice-chairman, shall be responsible for presiding over, and planning and arranging the program of his section.

a) The Chairman shall be responsible for transmission of program material to the Secretary by the deadline recommended by the Secretary and approved by the Executive Committee.

b) The Chairman, in cooperation with the Vice-chairman, shall endeavor to build up the membership of the Section.

c) The Section Chairman should write to the members of his section, previous to the secretary's "Call for Titles," encouraging them to participate in the upcoming Meeting. In this letter he shall also solicit names of qualified nominees for vice-chairman if that position is about to be vacated.

d) At the Friday morning paper session the section members shall vote on which nominee they want for the upcoming two (2) years as vice-chairman. The section's choice should be delivered to the Chairman of the Academy Nominating Committee not later than the close of the Friday afternoon session.

e) The Section Chairman shall be alert to the fact that only members in good standing are qualified to be considered for elective positions in the Academy.

Sec. 7. Section Vice-Chairmen: Each Vice-chairman shall cooperate with the Chairman in the efficient handling of all sessions at the annual meeting.

a) The Vice-chairman shall be secretary of the business meeting of the section and make his report to the Academy Secretary before the annual business meeting.

b) In the event that the office of section chairman is vacated, the vice-chairman shall serve as temporary chairman.

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c) He shall be a member of the Membership Committee of the Academy and shall be responsible for building up the membership in his section with the assistance of the chairman.

Sec. 8. Secretary: The Secretary shall maintain an accurate and up-to-date roster of the Academy membership and their dues record.

a) The Secretary shall send dues statements to the members for the next calendar year.

b) The first dues notice shall be sent October 1, the second notice November 15, and the final notice on January 5. Members in arrears as of February 1, will be dropped from the roll of the Academy and all publications to said member discontinued.

c) Upon receipt of dues the Secretary shall check the roll of the members in good standing and forward the funds to the Treasurer.

d) He shall notify applicants of action on their application of membership.

e) He shall keep the minutes of the Executive Committee and of the Academy as a whole.

f) The Secretary in concert with the Chairman of Local Arrangements Committee, shall be responsible for the arrangements of the annual meeting, including the drawing up of the general program and the arranging of Sectional, Junior Academy and Gorgas programs sent to him by persons in charge of each area.

g) He shall be in charge of the preparation, printing and mailing of meeting programs, blanks, notifications, etc.

h) The Secretary shall provide the incoming President with a revised roll of the Academy membership. He shall also provide each Section Chairman with an up-to-date list of the members in his or her section.

Sec. 9. Treasurer: The treasurer shall be the recipient of all funds of the Academy derived from dues and fees as collected by the Secretary, but not special funds held by the Board of Trustees as provided by the Constitution.

a) The Treasurer shall prepare a budget for the next fiscal (calendar) year and present same at the Fall Executive Meeting.

b) The Treasurer shall prepare a financial statement of the Academy for the past calendar year and present same at the Spring Executive Committee Meeting.

c) The Treasurer shall make such disbursement of funds as approved in the budget.

d) The Treasurer is required to be bonded.

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Sec. 10. Councilor of the AAAS:

- a) He shall represent the Academy on the Council of the American Association for the Advancement of Science (AAAS) and the Conference.
- b) He shall attend any other meetings of the AAAS conventions which shall be deemed of interest to the Academy.
- c) He shall make a report at the Spring Executive Committee Meeting.
- d) The President is authorized to appoint a substitute or alternate Councilor of the AAAS.
- e) Other delegates up to five in number may be designated by the President to attend the annual meeting of the AAAS.

Sec. 11. Editor of the Journal:

- a) He shall be responsible for publication of the Journal of the Alabama Academy of Science.
- b) He shall be an ex-officio member of the Editorial Board.

Sec. 12. Counselors of the Junior Academy: The Counselors of the Junior Academy shall supervise the activities of the Junior Academy for the Senior Academy.

Sec. 13. State Coordinator of Regional Science Fairs: The State Coordinator of Regional Science Fairs shall supervise the activities of the Regional Science Fairs.

ARTICLE VI. PROGRAM RULES

- Sec. 1. Titles of the papers to be presented at the Annual Meeting of the Academy must be sent to the Chairman of the Section, in which the paper is to be presented, prior to the date set by the Executive Committee.
- Sec. 2. Abstracts, typed in the prescribed format, shall be transmitted in the following manner. The original abstract shall be sent to the Editor of the Journal prior to the date set by the Executive Committee. The member shall carry a photocopy of the abstract to the Meeting and present it to the presiding officer of the Section prior to giving the paper.
- Sec. 3. The Section chairman shall screen the authors of scientific papers against his section membership roster. One author must be a member in good standing with the Academy.
- Sec. 4. The Section chairman shall compile the program for his Section in the prescribed format and forward it to the Secretary prior to the date set by the Executive Committee.

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- Sec. 5. Failure to follow the above program rules will result in the Section Program being omitted from the final printed program.
- Sec. 6. A registration badge is necessary for admission to scientific paper sessions, panel discussions, seminars or symposia held under the auspices of the Academy. The only exception to this rule shall be the case of invited guests of the Academy.
- Sec. 7. The Program of the Annual Meeting shall include the following features:
- (a) Meeting of the Executive Committee.
 - (b) Annual Business Meeting of the Academy.
 - (c) Scientific Section Sessions.
 - (d) Annual Banquet.
 - (e) Meeting of the Board of Trustees.
 - (f) Other activities in keeping with the objectives of the Academy.

ARTICLE VII. JOURNAL

- Sec. 1. The Journal of the Academy shall be published at least once and not more than four times each year at the discretion of the Editorial Board. It shall contain an account of the business transacted at the annual meeting, papers of outstanding merit, abstracts of all other papers, and such other materials as the Editor and the Editorial Board may think proper.

ARTICLE VIII. THE ALABAMA JUNIOR ACADEMY OF SCIENCE

- Sec. 1. The Academy shall sponsor and supervise the Alabama Junior Academy of Science, composed of high school science clubs.
- Sec. 2. Counselors of the Junior Academy are officers of the Academy and are elected as provided in Article VIII of the Constitution.

ARTICLE IX. REGIONAL SCIENCE FAIRS

- Sec. 1. The Academy shall sponsor and supervise the Alabama Regional Science Fairs.
- Sec. 2. The State Coordinator of Regional Science Fairs is an officer of the Academy and is elected as provided in the Constitution.

ARTICLE X. AMENDMENTS

- Sec. 1. The By-Laws may be amended by a plurality vote of the Executive Committee present at any annual meeting or at any special meeting for that purpose.

Constitution and By-Laws

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11. J. Ala. Acad. Sci. 48:148-163. 1977.
12. Minutes of the Executive Committee Meeting, October 20, 1979. Southern Res. Inst., Birmingham.
13. Minutes of the Executive Committee Meeting, March 20, 1980. Samford Univ., Birmingham.
14. Minutes of the Executive Committee Meeting, October 11, 1980. Southern Res. Inst., Birmingham.

INSTRUCTIONS TO AUTHORS

Editorial Policy: Publication in the *Journal of the Alabama Academy of Science* is restricted to members. Membership application forms can be obtained from Dr. John Pritchett, Dept. of Zoology-Entomology, Auburn University, AL 36849. Subject matter should represent original research in one of the discipline sections of the Academy: Biological Sciences; Chemistry; Geology; Forestry, Geography, and Conservation; Physics and Mathematics; Industry and Economics; Science Education; Social Sciences; Health Sciences; Engineering; Anthropology. Timely review articles of exceptional quality and general readership interest will be considered. Manuscripts are published in order of acceptance. Each manuscript receives two simultaneous reviews.

Manuscripts: Consult recent issues of the *Journal* for format. Double-space manuscripts throughout, allowing 1-inch margins. Number all pages. Submit the original and two copies to the Editor. Papers which are unreasonably long and verbose, e.g., uncut theses or reviews, will be returned. The title page should contain the author's name, affiliation, and address, including zip code. An abstract not exceeding 200 words will be published if the author so desires. Use headings and subdivisions where necessary for clarity. Common headings are: INTRODUCTION (including a literature review), PROCEDURES (or MATERIALS AND METHODS), RESULTS, DISCUSSION, and LITERATURE CITED. Other formats may be more appropriate for certain subject matter areas. Headings should be in all-caps and centered on the typed page; subheadings should be italicized (underlined) and placed at the margin. Avoid excessive use of footnotes. Where few are used, number consecutively at the bottom of page where cited. Where large numbers are necessary, list them consecutively at the end of the manuscript under the heading, FOOTNOTES.

Illustrations: Submit original inked drawings (graphs and diagrams) or clear black and white glossy photographs. Width must be 14-15 cm and height must not exceed 20 cm. Illustrations not conforming to these dimensions will be returned to the author. Use lettering that will still be legible after a 30% reduction. Designate all illustrations as figures, number consecutively, and cite all figures in text. Type figure captions on a separate sheet of paper. Send two extra sets of illustrations; xeroxed photographs are satisfactory for review purposes.

Tables: Place each table on a separate sheet and type the title directly above it. Number tables consecutively. Use symbols or letters, not numerals, for table footnotes. Cite all tables in the text.

Literature Cited: Only references cited in the text should be listed under LITERATURE CITED. Do not group references according to source (books, periodicals, newspapers, etc.). List in alphabetical order of senior author names. Cite references in the text by number or by author-date.

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ABSTRACTS

Papers presented at the 58th Annual Meeting
Auburn University
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April 1-4, 1981

BIOLOGICAL SCIENCES

EFFECT OF TONICITY ON TRANSMEMBRANE POTENTIAL OF BIMERIA TUNICATA

D. Virginia Nancarrow and Richard L. Shoemaker. University of Alabama in Birmingham.

Bimeria tunicata occurs in fresh to saline waters. However, it was found to regress in fresh water. Microelectrode measurements showed a depolarization of the epidermal cell membrane with a salinity increase and a repolarization with salinity decrease. The greater the increase or decrease in salinity, the greater the change in potential. In most instances the magnitude of the potential change per unit time was greater as salinity was increased than when decreased and the less the difference in salinity change, the shorter the period required for the equilibration in membrane potential to be reached. The membrane was found to be more permeable to potassium than to sodium and more permeable to sodium than to calcium. When the ionic concentration was kept constant and the tonicity was changed by adding sucrose, the tonicity of the solutions was not found to be a factor in the change in membrane potential. The observed change in membrane potential does not appear to be sufficient to indicate an intracellular tonicity change to cope with fluctuating salinity. However, it is possible that an ionic change mediates enzymatic activity to mobilize amino acids or to promote synthesis in the opposite direction, thus producing conformation in intracellular tonicity to that of the outside medium.

NESTLING GRAY SQUIRREL VOCALIZATIONS

Robert S. Lishak. Dept. of Zoology-Entomology, Auburn University, AL 36849

Nestling gray squirrels (Sciurus carolinensis) produce calls described as squeaks, growls, screams, tooth chatter, muk-muk and lip smacking. Squeaks which function as the nestlings' primary distress call, were found to be suited ideally for easy localization. Spectrographic analysis of squeak notes shows that note frequency and internote intervals vary within note sequences. As nestlings mature, growl note and internote lengths vary. Although growls, screams and tooth chatter are all emitted during agonistic encounters, screams alone were found to fit the profile of a distress call, and may function as such.

Abstracts

SIGNIFICANCE OF REGRESSION ON SURVIVAL OF BIMERIA TUNICATA

D. Virginia Nancarrow. Dept. of Biology, Univ. of Ala. in Birmingham, Birmingham, AL 35294. Barry A. Vittor. Barry A. Vittor and Assoc., Inc., Mobile, AL 36609.

The estuarine hydrozoan, Bimeria tunicata, exhibits regression under adverse conditions. Polyps are lost and the coenosarc moves toward the hydrorhiza. If adverse conditions persist long enough, the result is death of the entire colony which becomes detached from the substrate. If there is a reversal of adverse conditions before the colony dies, tissue returns to the hydrocaulus and new polyps are produced. Reversal of regression was elicited in hydroids regressed for a period of over seven months. Factors which induce regression are fresh water, high salinity and absence of food supply. Regression reversal is induced by a reversal of these factors. Regression and regression reversal, as an adaptation to the estuarine environment, have not been demonstrated in other hydroids. This investigation suggests that this phenomenon plays an important role in adapting B. tunicata to the wide fluctuations typical of the Mobile Bay estuary.

THE FILTER APPARATUS OF LARVAL PELODYTES PUNCTATUS (AMPHIBIA: ANURA).

O. M. Sokol. Dept. of Anatomy, Col. of Med., Univ. South Alabama, Mobile, AL 36688 and Dept. of Herpetology, Calif. Academy of Sciences, Golden Gate Park, San Francisco, CA 94118

Parts of the larval filter apparatus (ventral velum, branchial food traps, filter plates) were studied, using the scanning electron microscope. The primary species studied was Pelodytes punctatus, but Alytes obstetricans, Pelobates cultripes, Scaphiopus holbrookii, Telmatobius culeus, Hyla cinerea and Rana sphenoccephala were also examined. Other data was taken from literature.

Previous authors, in similar studies, maintained that variations in larval filter apparatus morphology supported the anuran suborders Archeo- and Neobatrachia. The present study concludes that the larval filter apparatus cannot be used to support any subordinal arrangement, but affirms its potential value at lower systematic levels.

Pelobatoids tend to have modified filter apparatuses. Four types are recognizable: Pelodytes; Scaphiopus; Megophrys; Pelobates, Leptobrachium, Oreolalax. Although other beaked Asian genera remain unstudied, these groups indicate that current pelobatoid systematics is erroneous.

Pelodytes has the most primitive pelobatoid filter apparatus. This, the moderately derived larval chondrocranium and the peculiar mixture of certain primitive and derived character states in the adult frog (none shared with other pelobatoids), indicate a long independent phylogeny for Pelodytes. This in turn, supports recognition of a separate monogeneric family Pelodytidae.

DISTRIBUTION OF 5 α REDUCTASE ACTIVITY IN THE BULL EPIDIDYMIS

James T. Wyckoff*, M. H. Fazelli and V. K. Ganjam*. School of Veterinary Medicine, Auburn University, Alabama 36849

The distribution of 5 α reductase activity was determined in the epididymides of five normal bulls. Epididymides were divided into the following zones: (1) efferent ductules, (2) initial segment, (3) descending limb, (4) ascending limb, (5) middle corpus, (6) proximal cauda, (7) distal cauda and, (8) ascending ductus deferens. The activity of 5 α reductase was assayed in homogenates according to the method of Moore and Wilson as modified by Robaire *et al.* (J. Steroid Biochem. 8:307, 1977). Of the total caput 5 α reductase activity, 50.68% was in zone 4 with 15.36 and 33.96% in zones 2 and 3, respectively. The percent total epididymal 5 α reductase activity was 0.42, 5.28, 11.67, 17.43, 31.72, 20.71, 11.16 and 2.03 within zones 1, 2, 3, 4, 5, 6, 7 and 8, respectively. Enzyme activity in the testes was twice that found in zone 1 indicating that the efferent ductules play no role in the conversion of testosterone (T) to dihydrotestosterone (DHT). The levels of 5 α reductase activity found in the rest of the epididymis correlate with the regional distribution of DHT in the bovine epididymis shown by Ganjam and Amann (Endocrinology 99:1618, 1976). These investigators have also shown that the DHT:T ratio in bovine rete testes fluid is 1:25 whereas in cauda epididymal plasma the ratio is nearly 2:1. The suggestion is made that 5 α reductase, through the mediation of T to DHT interconversion may indirectly modulate DHT dependent synthesis of factors required for sperm maturation.

EFFECTS OF DISTURBANCE ON A POPULATION OF BALANUS TRIGONUS

Ann H. Williams. Dept. of Zoology-Entomology, Auburn University, AL 36849. J. P. Sutherland. Duke Univ. Marine Lab., Beaufort, NC 28516.

Ceramic tiles were placed on blocks parallel to the surface of a reef offshore from Beaufort, NC, in order to estimate recruitment and developmental rate of the barnacles. A set of tiles was elevated 1.5 m above the reef to estimate these rates in the absence of scouring and grazing. Barnacles on the front of tiles submerged for one month in April 1978 had a mean diameter of 1.23 mm and represent new larval recruits. Only 33% of the population on the front of tiles submerged for 4 months were larger than recruits while the protected tile backs exhibited populations with 74% of the individuals larger than this size class. The mean diameter of barnacles on the back of these tiles was 1.6 times larger than on the front. Tiles submerged for 7 months exhibited the same patterns. Elevated tiles exhibited equal mean diameters on front and back. No differences in the proportion of recruits and adults on either side were noted. Thus, a larger proportion of larvae are able to successfully settle and grow in the absence of disturbance.

Abstracts

DISRUPTION OF INHIBITION FOLLOWING SEROTONIN DEPLETION. Jane Crockard, E.J. Rickert, J.L. Lorden, D.T. Berry. Department of Psychology, Univ. of Alabama in Birmingham, Birmingham, Alabama 35294.

Recent work has shown that serotonin may play a role in enabling animals to habituate or ignore stimuli poorly correlated with reinforcement. Specifically, serotonin-depleted rats pre-exposed to a conditional stimulus (CS) do not show, as do normal animals, impaired learning when the CS is later employed as a signal for impending reinforcement. This possible inhibitory role of serotonin was evaluated in the present study by determining whether depletion of forebrain serotonin alters the associative strength of two stimulus elements which formed a compound stimulus after pre-exposure to one of the two stimulus elements. Rats with 6-hydroxydopamine lesions of the dorsal noradrenergic bundle (DB) or 5,7 - dihydroxytryptamine lesions of the midbrain raphe nuclei were compared to sham-operated controls in a design which crossed these factors against a stimulus pre-exposure and a control condition. When DB and sham rats were tested to the new stimulus the associative strength (indexed by response suppression) to that element was similar; however, serotonin depleted rats showed far less suppression. These data suggest that associative strength accruing to each element of the compound stimulus in the raphe lesion group were equivalent. This finding implies that prior exposure to a stimulus failed to alter the cue's associability and, consequently, may have resulted from an inhibitory deficit.

FURTHER THYROID FUNCTION STUDIES IN HIBERNATING CNEMIDOPHORUS SEXLINEATUS

Lawrence C. Wit, Jeffrey C. Sellers, and Bruce W. Gray. Department of Zoology-Entomology and Department of Anatomy and Histology, Auburn University, Auburn, AL 36849.

Previously reported data have indicated that plasma T-4 titers of hibernating Cnemidophorus sexlineatus are significantly higher than the plasma titers of their active counterparts. This study was undertaken in an initial attempt to ascertain if any seasonal changes in glandular secretion or peripheral utilization caused these changes. In order to evaluate secretion the thyroid glands of 308 C. sexlineatus were sectioned and histologically evaluated. Examination of both colloid and epithelium indicated an active thyroid in the summer and a more quiescent thyroid during the winter. Peripheral utilization was evaluated by measuring whole animal metabolic rate. Oxygen consumption data indicated that the metabolic rate of hibernating Cnemidophorus was significantly lower than active animals at each evaluated temperature (10°, 20°, 30°). It was concluded that seasonal changes in secretion and utilization occur which may alter plasma T-4 titers.

NEOTENIC GRAY SQUIRREL VOCALIZATIONS

Robert S. Lishak. Dept. of Zoology-Entomology, Auburn University, AL 36849

Calls produced by adult eastern gray squirrels were found to be morphologically and behaviorally reminiscent of those produced by nestlings. Tooth chatter and growl sounds which are produced by nestlings and adults, were found to change little with maturation. Solicitation calls emitted by nestlings appear to be related to rattle and mate calls produced by adults. Nestling squeak calls show behavioral and morphological similarity to juvenile screams and adult whinny vocalizations.

THE ICHTHYOPLANKTON POPULATION OF UPPER MOBILE BAY

Carole Crampton. Dept. of Life Sciences, Univ. of South Alabama, Mobile, AL. 36688.

A study of the ichthyoplankton population during the months September 1980 to March 1981 was conducted in the upper Mobile Bay. Five stations were sampled. Replicate five minute tows, using a $\frac{1}{2}$ meter diameter 505u plankton net, were made near the surface. In addition; dissolved oxygen, salinity, temperature, and pH were taken. Larvae were sorted and identified in the laboratory. Abundance and diversity of the ichthyoplankton was low during the fall and winter months with abundance increasing in the spring. Euryhaline species dominated. Species collected, in order of decreasing abundance, were Brevoortia patronus, Gulf Menhaden; Syngnathus scovelli, Gulf Pipefish; Lagodon rhomboides, Pinfish; and Leiostomus xanthurus, Spot. Greatest abundance occurred at one of the shallower stations, which was characterized by stable environmental parameters, and not directly influenced by river discharge.

AMINOPEPTIDASE AND ARGININE DIHYDROLASE IN SPIROPLASMAS

C. Stevens, Dept. of Agricultural Sciences, Tuskegee Inst., AL 36088, R.M. Cody and R.T. Gudauskas, Dept. of Botany, Plant Pathology, and Microbiology, Agri. Exp. Station, Auburn Univ., AL 36849.

Corn stunt spiroplasma (CSS) and Spiroplasma citri hydrolized arginine β -naphthylamide to arginine and β -naphthylamide as determined by the fluorometric method. Growing CSS in the presence of 47mM arginine resulted in a two-fold reduction in arginine aminopeptidase activity, indicating that synthesis of the enzyme might be subject to catabolic repression. Previously, it had been reported that CSS and S. citri metabolized arginine by the arginine dihydrolase pathway. When 25 μ g/ml of the antibiotic rifampicin was added to CSS cultures containing arginine, hydrolysis was blocked and growth of CSS was not stimulated. This suggests that some of the enzymes of the arginine dihydrolase pathway are inducible. Taken together, these experiments suggest a metabolic control relationship between the arginine dihydrolase pathway and arginine aminopeptidase system.

Abstracts

YEASTS ISOLATED AND IDENTIFIED FROM SELECTIVE ANIMAL SPECIES

Dorothy B. Geiger and Marie H. Attleberger, Dept. of Microbiology, School of Vet. Med., Auburn Univ., AL 36849.

An increasing number of yeasts were isolated from clinical specimens from nine animal species over a six-year period (1974 - 1980) as shown by laboratory records. The clinical specimens were obtained from animals presented to the Small and Large Animal Clinics and from animals being treated by practicing veterinarians. This study was undertaken 1) to identify the yeast isolated, 2) to see if animal yeast species were similar to those from humans, and 3) to compare two commercial yeast identification systems with the conventional Wickerham method. Twenty-nine yeast species out of 305 isolates were identified by one or more of the three identification systems and there was a high correlation between the systems. Animal yeast species appeared to be biochemically similar to human yeast species. The pathological role of some of the yeasts in animals was not known; however, in some cases yeasts were the known etiological agents of specific diseases.

HOME RANGE SIZE AND FEEDING HABITS OF THE EASTERN CHIPMUNK

Mark S. Blackmore and Robert S. Lishak. Dept. of Zoology-Entomology, Auburn University, AL 36849.

A population of eastern chipmunks, Tamias striatus, was studied through the summer and fall of 1980. Individuals were marked for identification and their home ranges determined using visual capture and fine grain following. Neither overall home range size nor daily ranges showed significant differences between seasons. Published reports of a summer lull were substantiated by decreases in both numbers and activity of individuals observed. Food preference studies were conducted during the peak autumnal foraging period. Arcs consisting of sunflower seeds, mixed sunflower seeds and acorns, or acorns only, were placed concentrically around the test subjects' burrows. Learning was reflected in patterns of foraging. Naive chipmunks consistently exploited the nearest food source before moving to more distant arcs. At the mixed food arcs acorns were usually taken in preference to sunflower seeds. Experienced animals seldom depleted the innermost ring before moving to the outer arcs; some bypassed this ring entirely. Significantly lower collecting times were documented for animals using acorns even when these were located twice as far from the home burrow than sunflower seeds.

OVARIAN HORMONES AND GLUCOSE-6-PHOSPHATE DEHYDROGENASE

Mohammad H. Fazeli, Diane W. Young, and V.K. Ganjam. Dept. of Physiology and Pharmacology, School of Veterinary Medicine, Auburn University, AL 36849.

Mammalian uterus exhibits some resistance against invading micro-organisms. This is at least partly modulated by the ovarian hormones. In a recent study at Auburn, stimulatory effects of estrogen and inhibitory effects of progesterone on phagocytosis and antibody production were demonstrated. Bactericidal properties of neutrophils which are mediated by their hexose monophosphate shunt activity and H_2O_2 production seem to be impaired with decreased glucose-6-phosphate dehydrogenase (G-6-PD) activity. The purpose of this study was to determine if ovarian hormones influence the activity of this enzyme. Estradiol cypionate (2 mg, I.M., n=6) or Reprogest (500 mg, I.M., n=6) were administered every fourth day to ovariectomized pony mares. While controls (n=6) received no treatment. Endometrial biopsies were obtained 7 days after initial treatment. Specific activities were expressed as picomoles/mg protein/minute. Activities ($\bar{x} \pm S.E.$) for estrogen, progesterone and control groups were 49.19 ± 5.89 , 35.33 ± 2.15 and 62.99 ± 9.40 , respectively. Analyses of the data indicated an inhibitory role for progesterone on G-6-PD activity. It appears that susceptibility to uterine infections could partly be mediated by inhibitory effects of progesterone on G-6-PD.

IMMUNOASSAYABLE LEVELS AND PHARMACOKINETICS OF INSULIN IN THE DOG: COMPARISON OF NORMAL AND DIABETIC DOGS

Carol Comerici*, William R. Ravis, Kyle Braund*, James T. Wyckoff*, William Hay* and V.K. Ganjam*. Schools of Veterinary Medicine and Pharmacy, Auburn University, AL 36849.

Efforts to establish pharmacokinetics of insulin in the canine were undertaken in order to provide a more rational approach to the treatment of diabetes mellitus in this species. A highly specific and sensitive insulin radioimmunoassay (Autopak^R, Micromedics) was adapted to the canine. Immunoreactive insulin levels in fasting, healthy dogs were $12.1 \pm 1.9 \mu U/ml$. A rise in immunoreactive insulin levels closely paralleled the rise in glucose levels during routine oral glucose tolerance tests. A significant correlation ($r=0.84$, $P<0.05$) between blood glucose and immunoreactive insulin concentrations was observed. Administration of NPH-insulin (.3 IU/lb, I.M.) resulted in peak insulin levels of $207.6 \pm 29.8 \mu U/ml$ within one hour and a biological half-life (NONLIN PROGRAM) of 53.2 ± 8.7 minutes. NPH and regular insulin given subcutaneously (.3 IU/lb) resulted in comparable peak times and biological half-lives. A greater percentage of administered NPH-insulin was eliminated by diabetic (alloxan-induced) dogs than was eliminated by normal dogs during the same time span. This decreased biological half-life of insulin in diabetic dogs over normal dogs strongly implies that insulin dosage treatments in vogue should be modified accordingly to gain effective therapeutic control.

Abstracts

ULTRASTRUCTURE OF CHLOROMYXUM TRIJUGUM IN ALABAMA FISHES

O.J.Booker and W.L.Current. Dept. of Zoology-Entomology, Auburn University, Auburn, AL 36849.

Scanning electronmicroscopy revealed that vegetative stages (plasmodia) of Chloromyxum trijugum (Myxozoa:Myxosporaea) in redear sunfish (Lepomis microlophus) and bluegill (Lepomis macrochirus) were attached to the gall bladder mucosal surface. Transmission electron-microscopy of the species-to-species interface revealed that plasmodia possessed membrane-bound pseudopodiumlike structures which touched or occasionally enveloped ends of mucosal cells. Topography of the luminal surfaces of plasmodia consisted of small, short ridges which project into the bladder lumen. Cell-to-cell interactions within plasmodia representing various aspects of spore production, or sporogenesis, will be discussed.

BRAIN NEUROSECRETION AND OVARIAN DEVELOPMENT IN THE HOUSE CRICKET

James T. Bradley, M. W. Swanson, and T. A. Simpson. Department of Zoology-Entomology, Auburn University, Auburn, AL 36849.

Paraldehyde fuchsin (PAF) stained serial sections of the brain of Acheta domesticus were examined for neurosecretory material (NSM) during adult ovarian development and in 10-day old ovariectomized animals. Neurosecretory cells (NSC) of the pars intercerebralis were low in NSM for the first 3 days of adult life, including the period during which vitellogenin synthesis and uptake are initiated. As mature oocytes accumulate after Day 4, NSM accumulates in the brain, reaching a peak by about Day 10. Ten-day old adults ovariectomized as last instar larvae contained dramatically less brain NSM than intact controls, and injection of 0.48 ug of ecdysterone into ovariectomized crickets partially restored the brain to a state resembling that of intact animals. Proteins from the brains and corpora cardiaca of intact and ovariectomized animals were analyzed by SDS-polyacrylamide gel electrophoresis, and their PAF stainability was assessed. Ovariectomy resulted in a decrease in the amounts of 12 brain peptides, but these showed little or no preferential staining with PAF. These data suggest that peptides responsible for the observed differences between the PAF reactivity of tissue sections from intact and ovariectomized animals may not be the most cysteine-rich peptides in the brain. The data also indicate the possibility of regulatory interactions between the brain and the ovaries.

OPIATE EFFECTS ON GASTRIC RESPONSES IN THE DOG

W. Anderson (introduced by B. I. Hirschowitz) & E. Molina, Div. of Gastroenterology, Univ. of Alabama and V. A. Medical Centers, Birmingham, Alabama 35294.

While vagal stimulation of gastric secretion can be completely blocked by atropine, gastrin release cannot. We used ENK, which blocks acetylcholine (ACh) release, to distinguish between vagal effects which depend on ACh release and those which do not. Six gastric fistula dogs (less in some exp.) were studied in 15 randomized experiments in which we measured 15 min gastric acid and pepsin (P) secretion and serum gastrin (SG) for 3 hrs. There were 5 one-treatment controls--saline infusion, ENK infusion (96 nM/kg.h), morphine sulfate infusion (96 nM/kg.h), Urecholine (URECH) infusion (.4 μ M/kg.h), 2-deoxyglucose (2DG) (625 μ M/kg) and urecholine step-dose (.1, .2, .4, .6 μ M/kg.h each for 45 min). In combination studies (a) 2DG was given at the start of a 2 hr infusion of (i) ENK 96 nM/kg.h, (ii) NAL 19 nM/kg.h or (iii) 96 nM/kg.h (iv) ENK & NAL together, (v) MS 96 nM/kg.h; (b) URECH dose responses were done with ENK background. RESULTS: Neither ENK nor saline stimulated gastric secretion or changed gastrin. MS increased acid and pepsin. ENK suppressed 2DG-vagal (but not direct cholinergic) stimulation of gastric H^+ and P, with unchanged H^+ :pepsin ratios. NAL did not block the ENK effect. MS increased 2 DG stimulated, but not direct cholinergic gastric secretion. Gastrin release was blocked by ENK only in the first 15 min. CONCLUSION: With vagal excitation (1) only initial gastrin release is cholinergic and another mechanism operates thereafter; (2) H^+ and P secretion are dependent on ACh release; (3) MS and MET-ENK have opposite effects.

ENDOGENOUS DEVELOPMENT OF THE SWINE COCCIDIUM, ISOSPORA SUI

David S. Lindsay, General Biology, Auburn University, AL 36849

The endogenous development of *Isospora suis* Biester 1934 is described in piglets inoculated with 150,000 or 200,000 sporulated oocysts. Endogenous stages developed within villous epithelial cells throughout the small intestine. Two distinct types of meronts were seen in tissue sections. Type I meronts, which were seen at 3 days postinoculation, were binucleate, elongate, and 10.5 by 4.7 μ m. They produced two to 14 Type I merozoites per parasitophorous vacuole. Type I merozoites were 10.0 by 3.6 μ m. Type II meronts, which were seen at 4 days postinoculation, were elongate and contained three to 12 nuclei. Type II meronts were 11.4 by 5.3 μ m, and one to four were found per parasitophorous vacuole. Type II merozoites were 6.3 by 2.1 μ m, and three to 16 were found per parasitophorous vacuole. The peak of asexual development occurred 4 days postinoculation. Fully developed microgamonts, macrogamonts, and oocysts were seen 5 days postinoculation. The prepatent period was 5 days, and the patent period was 5 to 8 days. No extraintestinal stages were seen.

Abstracts

PRECOCENES AFFECT YOLK PROTEIN SYNTHESIS AND EGG PRODUCTION IN THE HOUSE CRICKET

Philip A. Crockett, Lawrence C. Wit, and James T. Bradley, Department of Zoology-Entomology, Auburn University, Auburn, AL 36849.

Recently molted adult female house crickets (*Acheta domesticus*) were treated topically with either precocene 1 or precocene 2 in order to determine their sensitivity to the reported anti-juvenile hormone effects of the precocenes. It has been shown in many insects that yolk protein synthesis and egg production are under juvenile hormone control. Treated animals were exposed to either 200 ug of precocene 1 or precocene 2 dissolved in acetone; controls were treated with acetone alone. At 72 and 120 hours after adult ecdysis, hemolymph was collected and analyzed by SDS-polyacrylamide gel electrophoresis for the presence of female-specific yolk protein. In addition, at 120 hours each animal was sacrificed and the total number of mature eggs was determined. Precocene treatment resulted in a significant ($P < 0.05$) decrease in both the amount of yolk protein present in the hemolymph and in the number of mature eggs produced per animal. Precocene 2 reduced total egg production ($P < 0.05$), but had no apparent effect on the level of circulating yolk protein. Injection of C18-JH dissolved in paraffin oil into precocene-treated crickets abolished the effects of precocene upon circulating yolk protein and total egg production. Control animals receiving paraffin oil alone showed hemolymph yolk protein levels and numbers of mature eggs equivalent to those in crickets treated with precocene 1 alone. It was concluded that house crickets are more sensitive to precocene 1 than to precocene 2, and that precocene 1 affects the availability of juvenile hormone to the insect, a situation which can be reversed by supplying exogenous juvenile hormone.

GEL ELECTROPHORESIS OF AUTOGRAPHA CALIFORNICA NPV

S.P. Singh, Dept. of Biology, Alabama State Univ., Montgomery, AL 36195. R.T. Gudauskas and J.D. Harper, Dept. of Botany, Plant Pathology and Microbiology, and Dept. of Zoology-Entomology, Agri. Exp. Station, Auburn Univ., AL 36849.

Virions of a nuclear polyhedrosis virus of Autographa californica were analyzed by O' Farrell's two dimensional gel electrophoresis. Enveloped virions were solubilized in urea and subjected to isoelectric focusing in the first dimension. Electrophoresis in the second dimension was in the presence of sodium dodecyl sulfate (SDS), thus separating proteins on the basis of molecular weight. Isoelectric focusing in the first dimension was carried out in a small-diameter tube; SDS-electrophoresis in the second dimension was on a thin slab. About 35 different proteins ranging in molecular weight from 14,000 to 35,000 were resolved by this procedure. Usefulness of this technique for detection, analysis, and identification of a large number of proteins from complex biological systems is discussed.

THE RHIZOSPHERE: RELATION TO PATHOGEN BEHAVIOR AND ROOT DISEASE

Tom C. Creswell and E. A. Curl. Dept. of Botany, Plant Pathology, and Microbiology, Auburn Univ., Auburn, AL 36849.

Exudation of substances by plant roots influences the soil in their immediate vicinity by promoting or inhibiting microbial activity. This narrow zone of influence is called the rhizosphere. The rhizosphere together with the rhizoplane (the root surface) comprise the soil-root interface. Early in this century plant pathologists began to investigate the direct and indirect interactions of the rhizosphere with the soil microflora and fauna in relation to their influence on plant growth and disease.

Recent improvements in analytical methods have led to a better elucidation of exudate composition and sites of release from the root, as well as how exudation is affected by environmental conditions, foliar treatment, and plant injury. Special attention in recent years has focused on how the rhizosphere relates to biological control, nontarget effects of pesticides (especially herbicides), mycorrhizae, and allelopathy. Investigations in Alabama have revealed a favorable cotton-rhizosphere effect on populations of mycophagous Collembola. These minute arthropods feed on several plant pathogenic fungi, including *Rhizoctonia solani*, and may provide significant biological control of cotton-seedling disease.

INHIBITORY EFFECTS OF PRECOCENE UPON CRICKET EGG MATURATION

H. W. Haynes and James T. Bradley. Department of Zoology-Entomology, Auburn University, Auburn, AL 36849.

Female house crickets, *Acheta domesticus*, were treated with the "anti-juvenile hormone", precocene I, in order to determine a minimum treatment which would effectively limit egg production. The rationale for these experiments is based upon the known juvenile hormone dependency of egg maturation in most insect species. Newly molted adults were placed in glass petri dishes previously coated with varying amounts of precocene I. Crickets were transferred daily to freshly treated dishes during the first 1-4 days of adult life. The total number of eggs matured per individual by 5, 10, or 20 days postemergence for control and experimental animals was used to obtain dose-response curves for specific treatment regimens. Daily transfer of adult females to dishes freshly coated with 10 micrograms of precocene I per cm² during the first 3 days of adult life was found to be the most effective treatment in inhibiting egg production. Comparable precocene II experiments as well as juvenile hormone replacement therapy upon precocene treated crickets have also been performed. The information gained from these experiments is being used to evaluate the potential of precocenes as hormonally-based insecticides against a closely related pest species, the striped ground cricket, *Nemobius fasciatus*.

Abstracts

FOREBRAIN SEROTONIN AND THE ATTENUATION OF LATENT INHIBITION. David Berry, Edward J. Rickert, Joan F. Lorden. Department of Psychology, Univ. of Alabama in Birmingham, Birmingham, AL 35294.

In the latent inhibition (LI) paradigm animals are pre-exposed to a stimulus (A) which does not predict reinforcement. This pre-exposure retards learning if A is later used to signal reinforcement. Solomon et al. (1979), employing the LI paradigm, have shown that while normal animals displayed impaired learning to a stimulus previously uncorrelated with reinforcement, rats depleted of forebrain serotonin show no such habituation. However, Lorden et al. (1980) in a conceptually similar procedure found that norepinephrine depleted rats were unable to ignore stimuli which are irrelevant to the conditioned reinforcement; serotonic depleted animals, however, behaved similarly to controls. The present study aims to clarify the role of both norepinephrine and serotonin in the LI paradigm. The issue was evaluated by assigning 4 rats each to one of nine conditions cast in the form of a 3 x 3 factorial. One factor expressed whether rats received vehicle infusions (controls), 6-OHDA lesions of the dorsal and median raphe nuclei (R group). These conditions were crossed with three training conditions, namely a latent inhibition (LI) condition in which rats were pre-exposed to the to-be-conditioned CS; an S₂-S₁ condition in which the rats were pre-exposed to the to-be-conditioned CS accompanied by another equally salient cue (S₂-S₁); and a control condition in which there was no prior experience with the CS. Results show that serotonin depleted animals suffer an attenuation of the latent inhibition effect, while DB animals performance in the LI condition was similar to controls. These results imply a more complex process mediates this phenomenon than suggested by contemporary learning theory. (Supported by NSF Grant 55-9577).

EPICHLÖE TYPHINA AND THE TALL FESCUE TOXICITY PROBLEM

James F. White and E.M. Clark. Dept. of Botany, Plant Pathology, and Microbiology, Auburn Univ., Auburn, AL 36849.

Reduced weight gains in steers feeding on tall Fescue (Festuca arundinacea Schreb.) may be caused by mycotoxins produced by Epichloe typhina an endophyte of fescue. The fungal hyphae can be detected growing intercellularly within the pith and mesophyll of fescue grass by staining stem pith scrapings or peeled leaf-sheath sections with aniline blue and lactic acid and examining them microscopically. Material for examination has been stored frozen for nine months with no apparent impairment in the quality of the staining.

REPRODUCTIVE BIOLOGY OF THE ATLANTIC SHARPNOSE SHARK
RHIZOPRIONODON TERRAENOVAE (RICHARDSON)

Glenn Parsons. Dept. of Biology, Univ. of South AL., Mobile, AL 36688

Atlantic sharpnose sharks, Rhizoprionodon terraenovae (Richardson), were collected in the north central Gulf of Mexico from June 1979 to May 1980. The principal sampling devices employed were longline, trawl and gill net. Information was obtained from a total of 215 sharpnose during the study. Of this number, 144 were female and 71 were male. Free living specimens of sharpnose range in size from 30 to 107 cm total length. The sex ratio of embryos and immature individuals was found to be 1 male to 1 female while the adult sex ratio was found to be 1 male to almost 3 females. Clasper growth indicates males mature at about 80 cm total length while ovarian egg diameter show female maturation occurs at about 85 cm. The mating season of male and female sharpnose coincide closely with matings occurring primarily between mid-May and mid-July. Embryonic growth is rapid, gestation requires 10-11 months and parturitions probably peak in June. Pups are released near shore at an average of 32 cm total length. Statistical analysis suggests the existence of an optimal litter size for female sharpnose. A positive relationship was found between adult total length and litter size, with the largest individuals being the most fecund. However, polynomial regression analysis suggests the intermediate size adults produce the largest and therefore the most competitively fit progeny.

PROGESTERONE HALF-LIFE IN THE PREGNANT AND NONPREGNANT COW

W.H. Hay*, B. Bordoli*, R.S. Hudson*, W.R. Ravis, and V.K. Ganjam*. Schools of Veterinary Medicine and Pharmacy, Auburn University, AL 36849.

Four cows at 40, 60, 80, and 100 days of gestation underwent bilateral ovariectomy and a total of 19 blood samples was collected within the first 24 hours following surgery. Plasma progesterone was quantitated by a highly-specific RIA and a very fast disappearance during the first two hours was observed. This phase was followed by progesterone decline in a log-linear fashion consistent with first-order disappearance rates. From this data the biological half-life [$t_{1/2}(\beta)$] was calculated to be $13.18 \pm 1.19 \text{ hr}^{-1}$. In order to further understand the pharmacokinetics of progesterone in the bovine, an exogenous bolus of 500 mg of progesterone in ethanol was administered intravenously to 2 nonpregnant ovariectomized cows. A total of 25 samples was collected between 0 and 48 hours and plasma progesterone was quantitated by high pressure liquid chromatography. Calculation of $t_{1/2}(\beta)$ was determined to be 13.69 hr^{-1} . These preliminary data suggest the following: a) there were no apparent differences of progesterone disappearance rates between various stages of gestation consistent with the onset of abortion 3.5 ± 0.5 days following surgery and b) there are no apparent differences of progesterone half-life in endogenous vs. exogenous administration of progesterone in the bovine. These values should be of significant consequence in the treatment of progesterone insufficiency suspected in repeat breeders in cows.

CORTICOSTERONE BINDING IN ADRENAL INCUBATION MEDIA

M. L. Till, P. G. Campbell, J. F. Pritchett, J. T. Bradley and D. N. Marple. Departments of Zoology-Entomology and Animal Science, Auburn University Agricultural Experiment Station.

Media in which adrenal tissues have been incubated have been found to possess glucocorticoid binding activity. The purpose of the present study was to further investigate this phenomenon with regard to characterization of binding properties and changes therein in response to ACTH, cyclohexamide (an inhibitor of protein synthesis) and steroid-free medium from previous incubations. Binding activity may be by a CBG-like substance since a high affinity for corticosterone ($K_d = 1.135 \pm 0.083 \times 10^9$ l/m) but little or no affinity for dexamethasone was observed. Addition of ACTH in vitro increased corticosterone production, molar concentration of corticosterone bound and total protein concentration of the medium. Cyclohexamide depressed corticosterone production, had no effect on basal molar concentration of corticosterone bound and blocked the ACTH stimulatory effect on bound concentration. Addition of steroid-free medium blocked the ACTH stimulatory effect upon corticosterone production, total protein concentration, and molar concentration of corticosterone bound. These results suggest that the substance in question is CBG-like with regard to its binding properties. However, it is doubtful that the substance is CBG in view of the observation that ACTH stimulated its production and/or release in vitro, a response that was blocked by cyclohexamide or steroid-free media from previous incubations. It is proposed that the substance may function in a storage and/or secretory capacity.

EFFECTS OF FLORAL DENSITY ON GREEN CRAB PREDATION OF MUSSELS

Dorothy E. Sherrill. Dept. of Zoology-Entomology, Auburn University, AL 36849

A study was conducted on the effects different densities of simulated Spartina alterniflora would have on the predator-prey relationship between the green shore crab, Carcinus maenas and the ribbed mussel, Modiolus demissus. Three separate size classes of Carcinus were allowed to prey upon three size classes of Modiolus in different densities of simulated Spartina. It was found that for the large size class of crabs there was a significantly different foraging behavior in the high density of Spartina. The large crabs began to select a larger prey size of mussel in the high density. For the small and medium size classes of Carcinus there was no difference in their foraging behavior. These findings suggest that the environment in which Carcinus and Modiolus live plays a large role in predation behavior and intraspecific competition.

Abstracts

EFFECTS OF ENUCLEATION AND PINEALECTOMY ON SEASONAL CHANGES OF PLASMA TESTOSTERONE ESTROGENS AND GONAD WEIGHTS IN CATFISH.

Bonnie Brown, Tracy Smith, James Woodard, Robert MacGregor, Univ. Al., B'ham., 35294. Ken Davis, Cheryl Goudie and Bill Simco, Memphis St. Univ., 38152

Pinealectomy and/or enucleation (blinding) was performed on male and female catfish maintained outdoors in ponds or constant temperature tanks (21°C) from February through August, 1979. Plasma gonadal steroids (testosterone in males and estrogens in females) were measured by radioimmunoassay. Blinding had no effect on the seasonal fluctuations of plasma gonadal steroids of either sex. Pinealectomy advanced the spring peak of plasma gonadal steroids to March from April in both sexes. Neither blinding and/or pinealectomy nor constant temperature (21°C) altered testicular recrudescence. However, blinding and/or pinealectomy delayed ovarian recrudescence in pond reared females, whereas, these treatments had no effect on ovary growth of females held at constant temperature. These data suggest two levels of gonadal development. The seasonal photoperiodic stimulation of testicular or ovarian weight appears to have little or no dependence on eyes or pineal organ. However, seasonal photoperiodic stimulation of plasma gonadal steroids appears to be negatively influenced by the pineal organ in the presence or absence of eyes. We gratefully acknowledge the assistance of Nick Parker and other personnel at the Southeast Fish Culture Center, Marion, Al.

ANNUAL DISTRIBUTION OF TWO MYXOZOAN PARASITES OF NOTROPIS CHRYSOCEPHALUS

William L. Current and Cynthia C. Thye, Dept. of Zoology-Entomology, Auburn Univ. AL 36849

The annual prevalence of two gill-parasitizing myxosporidians and encysted metacercariae of Crassiphilia bulboglossa (Trematoda: Diplostomatidae) were examined in the Striped Shiner, Notropis chrysocephalus. Plasmodia of the two species of Myxobolus were distinguished by their location on the gills and by the type of spore they contained. The distribution of both myxosporidan species for the 12 month study appeared over-dispersed ($\bar{x} < s$). The population distribution of both species of Myxobolus could be described best by negative binomial distributions. Fish were most heavily infected by the two myxosporidians from November through April when water temperatures were relatively low, 11 to 15°C. Both myxosporidan populations decreased when water temperature increased to 21°C and remained low from June through October. Mean numbers of plasmodia were significantly higher on the right when right and left gill bars were compared. Most of the myxosporidan plasmodia were concentrated in smaller fishes while metacercariae of C. bulboglossa were more abundant in larger fishes. Reproductive strategies of the three parasites will be discussed.

Abstracts

A DESCRIPTIVE ANALYSIS, MEDICAL AND PHYSIOLOGICAL OF ALABAMA JOGGERS

Rick Carter. Department of Health and Physical Education, Jack Hataway,* Glenda Barnes,* Helen Hunter,* and Patti Clark.* Department of Preventive Medicine, University of Alabama in Birmingham, Birmingham, AL 35294.

The purpose of this investigation was to identify, through questionnaire format, medical and physiological characteristics of an unsupervised jogging population in Alabama. A total of 938 Alabama joggers were surveyed to ascertain prevalent data related to their medical and physiological characteristics. Results indicate that a large percentage of the population possesses family histories of coronary heart disease risk factors and many of the joggers indicated prevalence of severe itching and hives, asthma, bloody urine, dizziness, blackout spells, heat exhaustion, severe ear obstruction, and chest pain not aggravated by deep breathing. Reported frequencies for the complications cited above ranged from 3 to 29 percent. To date, no data have been reported on the prece-dence of these problems in a jogging population. In addition, 96% of this population ranks itself in excellent to good health while primarily employed in sedentary professions (approximately 60%). When questioned as to time and distance jogged per week, mean responses averaged 5.03 hours and 27.8 miles respectively. It is quite interesting to note that the greatest distance covered (over 30 miles per week) occurred in the oldest reporting population. Overall the jogging population does not appear to adhere to established guidelines in pursuing exercise regimes with a central focus being the lack of medical exams and graded exercise tests performed on these 30 years of age and older. Therefore, careful attention should be devoted to further identification of specific medical and physiological attributes of joggers with specific recommendations regarding screening, treatment, and exercise-prescription.

DIETARY CALCIUM DEFICIENCY AS A CAUSE OF WATERY FECES IN LAYERS

Debra K. Caldwell and David A. Roland, Sr.*, Poultry Science Department, Ala. Agricultural Experiment Station, Auburn University, AL 36849

Experiments were conducted to determine the influence of calcium deficiency on the consistency of feces. Hens were fed dietary calcium levels of 3.0% and .05% in Experiment 1 and 3.75%, .53%, and .08% in Experiment 2 for 10 days. The criteria used were feed and water consumption, total feces excreted, and percent moisture of feces. The hens fed the calcium-deficient diets consumed less feed and water and excreted less total feces than the hens fed the control diets (3.0% and 3.76% calcium). Hens fed the control diets excreted well formed feces throughout the experiment. Hens fed the calcium-deficient diets excreted pronounced watery feces within 3 days. However, there was no difference in percent moisture between the well formed and watery feces. The results indicate that dietary calcium deficiency causes watery feces by reducing its water holding capacity.

EFFECTS OF THYROID STATUS AND AGE ON ADRENOCORTICAL FUNCTION

Margaret L. Till and John F. Pritchett. Dept. of Zoology-Entomology, Apri. Expt. Station, Auburn University, Alabama 36849

Age-related changes in the function of the hypothalamic-pituitary-adrenocortical (HPA) axis are well documented, as is the dependence of the adrenal cortex upon normal thyroid function. Nevertheless, the nature of these changes and dependency, the level of the HPA axis at which they exist, and their interaction are not known. The present study was undertaken to further delineate these questions. Adrenal glands from young (148-164 da) and mature (385-401 da), intact and thyroidectomized, male rats (Sprague-Dawley) were incubated initially for 15 minutes and subsequently for 60 minutes. During second incubations glands were exposed to ACTH (200mU/ml) and/or theophylline (10mM) or no stimulation. Media were analyzed for corticosterone content and glands for cyclic AMP content. During first incubations young and mature glands exhibited similar levels of secretion; thyroidectomy in both age groups diminished corticosterone secretion. In second incubations without stimulation, young-intact animals secreted corticosterone in quantities similar to the first incubation; however all other groups exhibited higher levels. Theophylline treatment increased corticosterone secretion in young groups, thyroidectomized and intact; whereas ACTH stimulation increased secretion of intact groups. Concurrent application elevated corticosterone in all groups except the mature-athyroid. The presence of theophylline elevated glandular c-AMP in all groups with the exception of the mature-athyroid; ACTH failed to increase the cyclic nucleotide. Combination treatment followed the same pattern as theophylline. In summary it would appear that thyroid hormones are essential for adrenocortical response to ACTH regardless of age status and that age-related changes compromise the stimulatory capabilities of theophylline in mature glands.

INFECTION OF PLANT PROTOPLASTS WITH MAIZE DWARF MOSAIC VIRUS

V.K. Varner and R.T. Gudauskas. Dept. of Botany, Plant Pathology, and Microbiology, Agric. Exp. Station, Auburn Univ., AL 36849

High yields (2.4×10^6 and 3×10^5 protoplasts/ml) of corn and johnson-grass mesophyll protoplasts that were susceptible to maize dwarf mosaic virus (MDMV) were obtained by incubating diced leaf sections in an isolation medium containing 2% cellulysin and 0.5-0.6M mannitol. For inoculation, protoplasts were incubated with purified MDMV (11-60 $\mu\text{g/ml}$) in a medium containing mannitol, phosphate buffer, and poly-L-ornithine. Serum specific electron microscopy showed increasing numbers of MDMV particles in protoplast preparations made at intervals after inoculation. Levels of infection were increased by subjecting protoplasts to osmotic shock during inoculation. Infectivity and fluorescent antibody assays are being evaluated for detecting virus or virus protein in protoplasts.

SOME REACTIONS OF THE SULFHYDRYL GROUPS OF HEMOGLOBIN

Betty M. Hawk. Chemistry Dept., Birmingham-Southern College, Birmingham, AL 35204. Gerald L. Carlson, Dept. of Biochemistry, Univ. of AL in Birmingham, Birmingham, AL 35294.

A mixed disulfide of human hemoglobin and 5-thio-2-nitro benzoic acid was made to test for the effects of a bulky group in place of the normally-reactive sulfhydryl group of the β -93 cysteine residue of this hemoglobin. As found by Mansouri using a thioether derivative of the β -93 residue (1), the oxidation of the oxygenated form of the mixed disulfide with nitrite was insensitive to the inhibitory effects of inositol hexaphosphate (IHP) that are evident in the oxidation of unmodified oxyhemoglobin with nitrite. Since the β -93 sulfhydryl group is unreactive in the deoxy-conformer due to screening by the salt bridge between the β -chain Asp-94 and His-146 residues (2), it is proposed that introduction of either a thioether or a disulfide linked substituent on the β -93 residue locally prevents a modification of hemoglobin structure that is induced by IHP. Retention of a tertiary structure compatible with the attack of nitrite can account for the lack of effect of IHP on the oxidation process.

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5 α REDUCTASE IN RAT CAPUT EPIDIDYMIS MAINTAINED IN CULTURE

Diane W. Young, Marlane J. Angle, and V.K. Ganjam. Dept. of Physiology and Pharmacology and Bruce W. Gray. Dept. of Anatomy, School of Veterinary Medicine, Auburn University, AL 36849.

The activity of 5 α reductase (Δ^4 -3 ketosteroid 5 α oxidoreductase), a key enzyme in testosterone metabolism in male target organs, was determined in rat epididymal tubules under various conditions of organ culture. Conditions that resulted in the best histological appearance after 24 hrs. in culture involved the use of tissue culture Medium 199 (GIBCO 330-1180) containing 0.5 μ g/ml dihydrotestosterone at 32°C, using a gas phase of 5% CO₂, 95% O₂. Under these conditions 5 α reductase activity could be maintained in isolated epididymal tubules cultured for 16 hrs. at greater than 50% of the activity of fresh tissue. This system will be utilized to investigate the in vitro effect of compounds known to have an in vivo effect on 5 α reductase or on epididymal function.

Abstracts

ENDOGENOUS STAGES OF EIMERIA ROPERI IN THE COTTON RAT

Suzanne A Whitlock, and William L. Current, Dept. of Zoology-Entomology, Auburn Univ. AL 36849.

Endogenous stages of Eimeria roperi (Protozoa: Eimeriidae) were studied in the cotton rat, Sigmodon hispidus. Asexual endogenous stages were in the surface epithelial cells and the central cavity or lumen of the crypts of Lieberkuhn in the cecum and colon. The majority of sexual endogenous stages were found in the surface epithelial cells in middle and lower regions of the crypts of Lieberkuhn in the cecum and colon. E. roperi had a typical coccidian endogenous cycle that consisted of three asexual schizogenous generations followed by sexual stages which produced macrogametes and microgametes. No parasites were in sections from the stomach, small intestine, liver, spleen, or kidneys.

SCENT MARKING BEHAVIOR IN THE GREY SQUIRREL

Linda Jean Mason and Robert S. Lishak. Department of Zoology-Entomology Auburn University, AL 36849.

A method of studying scent marking behavior in the grey squirrel was identified and developed along with marking techniques. Laboratory rats were injected subcutaneously and intraperitoneally with various volumes and concentrations of an industrial dye called Rhodamine B. It was found that a solution of 10 gms. Rhodamine B and 1000ml H₂O injected intraperitoneally using various volumes lasted a maximum of 84 hours for the females and 81 hours for the males. Various methods of marking individual squirrels are discussed including tail fur clipping, fur dyeing, ear tagging, and freeze branding.

PREPARATION OF GARDEN SOIL IN NORTHEAST ALABAMA

Thomas Cochis, R. David Whetstone, and Kenneth E. Landers, Dept. of Biology, Jacksonville State University, Jacksonville, AL 36265.

A series of 2x2 Kodachrome slides were used to show how a heavy clay soil in Calhoun County unsuitable for gardening, can be changed to a loose, friable soil ideally suited for this purpose. Well rotted sawdust, lime and a balanced fertilizer were used. Samples of the soil before and after preparation were shown. Five years were required for total preparation with the soil showing steady improvement from the first year.

Abstracts

CULTIVATION OF KIWI (ACTINIDIA CHINENSIS PLANCHON) IN NORTHEAST ALABAMA

Kenneth E. Landers, Thomas Cochis and R. David Whetstone. Dept. of Biology, Jacksonville State University, Jacksonville, AL 36265.

Kiwi or Chinese gooseberry was grown from seed in 1971 and cultivated in a garden in Jacksonville. Culture techniques included the application of 8-8-8 fertilizer, chicken manure and cow manure in the spring. The plants were mulched with leaves in early fall since new growth was often killed back by late spring frost. One arbor, located in partial shade on which both female and male plants are growing, is approximately 8 meters long, 2 meters wide and 2 to 3 meters tall. Six to seven dozen fruit were harvested in 1978.

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SOME ASPECTS OF DISPERSAL IN THE VASCULAR FLORA OF THE CUMBERLAND PLATEAU OF ALABAMA

Whetstone, R. David, Kenneth E. Landers, and Thomas Cochis, Dept. of Biology, Jacksonville State University, Jacksonville, AL 36265.

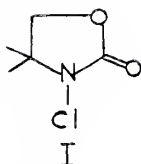
A study of the dispersal spectra represented in the flora of the Cumberland Plateau reveals most taxa are dispersed by wind and animals. In addition, almost one fourth of the taxa exhibit no specialized dispersal mechanisms. These computer-assisted tabulations and cross tabulations include almost 98% of the documented flora of the plateau of Alabama.

Abstracts

CHEMISTRY

A NOVEL BACTERICIDAL AGENT FOR TREATMENT OF WATER. D. Burkett, J. Faison, H. H. Kohl, W. W. Wheatley and S. D. Worley, Department of Chemistry, Auburn University, Alabama 36849 and N. Bodor, Department of Medicinal Chemistry, University of Florida, Gainesville, Florida 32611.

A novel bactericidal agent 3-chloro-4,4-dimethyl-2-oxazolidinone(I) has been synthesized and purified by an efficient procedure and tested as a water-treatment agent. The agent has been demonstrated



to be effective against eight types of bacteria which might be present in a water supply. In fact, the agent appears to be equally effective as compared to gaseous chlorine. Testing procedures and associated spectroscopic data for I will be discussed.

A SPECTROSCOPICALLY RESOLVED PULSED CO₂ LASER. M. R. Colberg, and O. D. Krogh, Department of Chemistry, Auburn University, Alabama 36849

A pulsed CO₂ laser has been developed by flash photolysis of CO₂:CS₂:O₂:NO₂ mixtures, involving energy transfer from CO to CO₂^{1,2}, and by flash photolysis of CO₂:Br₂ mixtures, involving energy transfer from Br* to CO₂¹. The laser emission in the 10 micron region has been resolved with a 1-meter Jarrell-Ash monochromator and spectroscopically identified. Experimental parameters like sample composition, flash energy and total sample pressure have been optimized. Investigation of emission in the 16 micron region is in progress and data will be presented to the extent they are available. As a pulsed laser this represents a valuable probe of vibrational excitation of product CO₂ in gas phase reactions.

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Abstracts

CARBON-METAL BONDS STUDIED BY MATRIX ISOLATION. G. Cook, O. D. Krogh,
Department of Chemistry, Auburn University, Alabama 36849

The carbon-metal bond has been studied for some metal-alkyl radicals by isolation in inert gas matrices. Metal atoms, both main group and transition group metals, were deposited with a resistively heated Knudsen cell. Methyl radicals were provided by photolysis of the matrix of azomethane. Reaction during warmup of the matrix was followed by infrared spectra in absorption and by optical multichannel analyzer (OMA) spectra in emission. The project is presently in progress and will include work with the metals Mg, Al, Ti and Zn.

FORMER PROFESSORS OF CHEMISTRY, UNIVERSITY OF ALABAMA

Emmett B. Carmichael, Med. Center, U.A.B., Birmingham, AL.

John William Mallet, b. 10/10/1832, Dublin, Ire., B.A.; Ph.D.; M.D.; LL.D., Professor of Chemistry, 1855-1860, d. 11/6/ 1912.

Jack Percival Montgomery, b. 7/18/1877, Columbus, MS., B.A.; M.A.; Ph.D., Professor of Organic Chemistry, 1918-1948, d. 5/20/1973.

Stewart Joseph Lloyd, b. 9/12/1881, Hamilton, Can., B.A.; M.S.; Ph.D.; D. Sc., Professor of Chemistry 1909 and Dean School of Chemistry, Metallurgy, and Ceramics, 1928-1959, Herty Medalist 1957, d. 8/5/1959.

Ernest Victor Jones, b. 1/7/1882, Bronaugh, MO., B.A.; M.A.; Ph.D.; D. Sc., Professor of Analytical Chemistry, 1947-1952, d. 7/21/1970.

Hsien Wu, b. 11/24/1893, Foochow, China, B.S.; Ph.D., Visiting Professor of Biochemistry, 1949-1953. d. 8/8/1959.

James Lyle Kassner, b. 11/6/1894, Whitehall, MI., B.A.; M.S.; Ph.D., Professor of Analytical Chemistry, 1946-1970. d. 6/24/1970.

PHOTOLYSIS OF CYANOGENAZID, CN_4 , STUDIED BY MATRIX ISOLATION. J. Hollenbeck, O. D. Krogh, Department of Chemistry, Auburn University, Alabama 36849

The photolysis of cyanogen acid, CN_4 , has been studied in solid argon matrices at $10^{\circ}K$. A safe, convenient procedure for synthesis of CN_4 from $ClCN$ and NaN_3 has been developed to give a product of high purity.

The primary photolysis process to N_2 molecules and NCN radicals has been confirmed¹ by infrared spectra and further substantiated by the blue emission (visible) associated with warm up of photolyzed samples to $30-40^{\circ}K$. The assignment of this thermoluminescence is presently in progress, as is the investigation of the possibility of secondary photolysis of NCN radicals to give N_2 molecules and C-atoms. This is done by identification of the products from the reaction between ethylene and photolyzed CN_4 in the argon matrix.

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THE APPLICATION OF HIGH PRESSURE LIQUID CHROMATOGRAPHY TO ANALYSIS OF UREA FERTILIZER IMPURITIES

Robert G. Howard, E. Richard Austin, Robert C. Horn, The International Fertilizer Development Center, Muscle Shoals, AL 35660, and Thomas P. Murray, Department of Chemistry, University of North Alabama, Florence, AL 35630

Commercial processes for the synthesis of urea from ammonia and carbon dioxide give rise to impurities such as hexamethylene tetra-amine, biuret and triuret. Biuret, which arises from excessive heating, is troublesome due to its phytotoxicity. Triuret can hydrolyze to biuret and is therefore potentially phytotoxic also. The toxicity is particularly acute in application to small grain seedlings and citrus fruits. The currently used wet method for biuret in urea is a colorimetric procedure and no suitable method exists for triuret.

High pressure liquid chromatography has been applied to this problem with good results. A C-18 reverse phase column has been used to separate urea from biuret and triuret. A good separation was achieved by isocratic elution with a potassium phosphate buffer. An ultra-violet detector was used and the effect of buffer pH on elution characteristics explored. Quantitative results for biuret in several samples of fertilizer grade urea will be presented.

Abstracts

GEOLOGY

GEOLOGY OF THE TERRAPIN CREEK AREA, CLEBURNE CO., ALABAMA

Gregory M. Guthrie, Dept. of Earth Science, The University of Alabama in Birmingham, University Station, Ala, 35294.

Along the Alabama-Georgia border, Valley and Ridge sedimentary rocks and Talladega metamorphics are juxtaposed along the Cartersville Fault. This south to southwest dipping, northwest to west trending, low angle thrust fault truncates north to northeast trending folds of the Valley and Ridge Province. Lower Paleozoic sedimentary rocks include Cambrian and Ordovician Knox and Newala carbonates, the Ordovician Rockmart Slate and the Devonian Frog Mountain Sandstone. To the west of these sedimentary rocks is a turbidite sequence of unknown age also over-ridden by the Cartersville Fault. Phyllites and Quartzites of the Talladega belt contain lithologies similar to that of the turbidite sequence but of a more crystalline nature. In the area of investigation, dips in the Valley and Ridge rocks are moderate to steep with a pervasive axial plane cleavage, folds in these rocks are upright to slightly overturned. Talladega rocks exhibit gentle dips and isoclinal folding. Structural style of the turbidite sequence is more closely related to that of the Talladega belt than that of the adjacent Valley and Ridge rocks. Trend of the turbidite sequence is the same general trend as the Talladega belt. It is suggested that the contact between the turbidite sequence and the Valley and Ridge rocks is a thrust fault rather than stratigraphic.

DAUPHIN ISLAND HUMATES: A RE-EXAMINATION OF THE OUTCROP AFTER HURRICANE FREDERICK

Norman B. Cranford, Auburn Univ., Auburn, AL 36849

The term humate is used geologically by Swanson and Palacas (1965) in a collective sense to refer to any of a group of very acidic gel-like solid humic substances in sediments. Dauphin Island is located in the humid coastal area of the eastern United States. Humate occurs, in these humid areas, as the matrix in siliceous sand and is particularly well developed in coastal deposits of Pleistocene age (Ervin G. Otvos, Jr. 1972). In 1978, I investigated the outcrop of a humate deposit located in an eroded area of a low wave-cut terrace on the Gulf side beach of Dauphin Island, Alabama. This paper describes the results of a re-examination, in February of 1981, of the Dauphin Island humate location and takes into consideration the changes in the outcrop caused by Hurricane Frederick in September of 1979.

Abstracts

A MAFIC-ULTRAMAFIC COMPLEX NEAR EASTON, TALLAPOOSA CO., ALABAMA

Calvin Allison and Michael J. Neilson, Dept of Earth Science,
The University of Alabama in Birmingham, University Station, Ala,
35294.

A small (less than 2 sq. km) mafic-ultramafic complex situated 2 km southeast of Easton is part of the intrusive mafic rock series within the Dadeville Complex of Alabama's Inner Piedmont. The complex consists of a pluton of olivine gabbro and a sill-like body of orthopyroxenite surrounded, and separated, by a thin (in places less than 20 m. thick) rim of amphibolite. Both the gneiss/complex contact and foliations within the amphibolite parallel foliations in the enclosing Camp Hill Gneiss. Although the plutonic rocks show no evidence of recrystallization, metamorphic effects are seen in the growth of secondary amphibole in the gabbro and decussate talc-anthophyllite-chlorite aggregates in the orthopyroxenite. Petrographically and geochemically the gabbro and the orthopyroxenite are typical of the Slaughters and Doss Mountain Suites, respectively. However, this complex is notable for the lack of rocks of noritic composition - a feature of the Doss Mountain Suite. The geochemistry of the amphibolites is transitional between the gabbro and the orthopyroxenite and is similar to that of the amphibolites surrounding the Red Ridge Pluton to the south of Dadeville. Collectively, these amphibolites are representative of a third episode of pre-tectonic mafic igneous activity in the Dadeville Complex.

THE PALYNOLOGY OF THE MARY LEE GROUP (PENNSYLVANIAN) OF THE BLACK WARRIOR BASIN, ALABAMA

Eric G. Woerner and Robert A. Gastaldo. Dept. of Geology, Auburn
University, AL 36849.

The Mary Lee coal group has demonstrated its capability as an economically viable gas producer with an estimated potential of one trillion cubic feet of recoverable methane. The reason for this high methane content is questionable. The Mary Lee and Blue Creek coals of the Warrior Basin were palynologically characterized to help determine if an unique floral assemblage is responsible for high methane content, or if the gas content is solely a function of burial depth, or possibly a combination of both factors. Dominant palynomorphs are representative of ferns and pteridosperms, which are understory components. The microfloral assemblages within individual seams of the Mary Lee group appear to be consistent. However, a comparison between the Mary Lee and Blue Creek microfloras reveals that slight variations exist between the two. This variation of plant composition, though, probably has little influence on the high methane content of the deep lying Mary Lee coal found in the central region of the Black Warrior basin. Microfloral distribution patterns have been assessed and compared to other characteristic microfloral assemblages of similar aged coals. On a time-stratigraphic basis, the Mary Lee coal group correlates with Appalachian coals of Lower New River age, and European coals of Westphalian A and B ages.

Abstracts

PALYNOLOGY OF AN INDIAN DWELLING SITE ALONG THE ALABAMA RIVER: AN INTRODUCTION TO PALYNOLOGICAL TECHNIQUES

Cortland F. Eble* and Robert A. Gastaldo. Department of Geology, Auburn University, AL 36849.

Recent archaeological investigations of Indian dwelling sites along the Alabama River have documented the dietary habit of the nomadic tribes through the identification of megascopic remains. It has been inferred that these Indians were strictly gatherers, but some concern exists as to whether these tribes may have cultivated maize. In order to attempt reconciliation of the possible cultivation of domestic crops, a palynological investigation of a trash heap associated with an Indian dwelling site on Ivy Creek was conducted. Previously collected sediment samples were provided by Dr. J. Cottier, Auburn University, and these were macerated according to standard palynological techniques. The recovered palynomorphs were not abundantly preserved, and this condition is probably related to the ephemeral nature of the depositional site. Non-arboreal pollen and non-vascular spores dominate the assemblage, and little arboreal pollen has been recovered. A reconstruction of the paleoecology of the dwelling site based upon the pollen spectrum suggests that the vegetation was a mosaic of bottomland forest, shrub thickets and ephemeral ponds.

THE DADEVILLE COMPLEX - A REVIEW

Michael J. Neilson, Dept. of Earth Science, The University of Alabama in Birmingham, University Station, Ala, 35294.

The Dadeville Complex of Alabama's Inner Piedmont occupies most of Tallapoosa and Chambers Counties and is bounded by the Coastal Plain Onlap, the Brevard Zone and the Stonewall Line. Five lithologic units are mapped on a regional scale. The metapelitic Agricola Schist-Gneiss is stratigraphically overlain by the Ropes Creek-Waverly Formation, a metamorphosed and interlayered volcanic/volcanoclastic series of mafic to intermediate composition. A metavolcanic-metaclastic sequence of amphibolites, actinolite-chlorite schists and quartzites, the Wareville Formation, may correlate with the Ropes Creek. The Mafic Intrusive Rocks, consisting of the Doss Mountain Suite (orthopyroxenite, norite and their metamorphic equivalents) and the Slaughters Suite (olivine gabbro and gabbro), are younger than the Ropes Creek. Felsic rocks are represented by the Camp Hill-Rock Mills Gneiss which is composed of basement (?) granitic gneiss, granitic and tonalitic gneiss, and post-metamorphic granite. Four episodes of deformation are recognized. The earliest episode generated macroscopic and mesoscopic isoclinal folds and was synchronous with prograde regional metamorphism. Post-metamorphic deformational events formed the Tallassee and Boyds Creek Synforms as well as mesoscopic cylindrical folding and caused widespread cataclasis. Major and trace element concentrations of the amphibolites and the mafic intrusive rocks indicate that during some part of its history the Dadeville Complex was an arc.

Abstracts

A PRELIMINARY REPORT ON THE PTERIDOSPERM DOMINATED TAPHOCENOSES ASSOCIATED WITH THE UPPER CLIFF COALS (POTTSVILLE), PLATEAU COAL FIELD, ALABAMA

Robert A. Gastaldo. Department of Geology, Auburn University, AL 36849.

Bituminous coal and associated megafloral coalified compression taphocenoses are present in significant quantities in the Lower Pennsylvanian Pottsville formation of northeastern Alabama. Detailed studies concerned with the early Pennsylvanian vegetation in the coal accumulating environments of the southern Appalachian coal field are virtually nonexistent. The interval of the Upper Cliff coals in the Plateau coal field provides an excellent opportunity to assess the megafloral taphocenoses, the morphological plasticity of taxa within similar and differing environments of deposition, and the relationship between biofacies and lithofacies. Preliminary megafloral quantification of selected intertributary bay deposits in Jackson, Marshall and Blount counties has documented that these taphocenoses are pteridosperm (seed fern) dominated. Mariopterids, Neuropterids and Lyginopterids are quite abundant in all localities sampled, although in areas which may have been influenced by brackish water, calamites appear to have been prolific. Mariopterids and Neuropterids are ubiquitous throughout the intertributary bay deposits, whereas Lyginopterids have been noted to be zoned directly above the coal horizon. Claystone paleosols are well developed at the cessation of intertributary bay fill and autochthonous *Stigmaria* are abundant. In at least one locality an autochthonous lycopod dominated forest has been identified.

FOSSIL WHALES IN ALABAMA

Daniel R. Womochel, Dept. of Geology and James L. Dobie, Dept. of Zoology and Entomology, Auburn University, Auburn, AL 36849.

Whales, the mammalian order Cetacea, first appeared as fossils in Eocene Age rocks in Africa, Asia, and Alabama. The taxonomic affinities of these whales, the suborder Archaeoceti, to modern whales, Odontoceti and Mysticeti, or to their terrestrial ancestors is unknown. Since their initial discovery in Alabama in 1834, few fossil Archaeocets have been found and no extensive research has been conducted on them after the publication of R. Kellogg's monograph by the United States National Museum in 1936. The Archaeocet whales became extinct during the Miocene. Recent field work in the Eocene of Alabama has resulted in the discovery of several new Archaeocet whales in Clarke, Washington and Choctaw Counties. The Clarke County whale, from the Lisbon Formation, is now being intensively studied at Auburn University. Preliminary studies of this specimen, a nearly complete skeleton, indicate that it may be the oldest fossil whale from North America. Comparison of this skeleton with published descriptions of other whales indicates that it is possibly a new genus or a genus not previously found on the Gulf Coastal Plain. The other new specimens, belonging to the genera *Zygorhiza* and *Basilosaurus*, remain to be excavated. Comparative study of these fossils will yield significant new data on the morphology, systematics, zoogeography, and paleoecology of the Archaeocet whales.

Abstracts

COAL PETROLOGY AND DEPOSITIONAL SYSTEMS OF THE LOWER PENNSYLVANIAN UPPER CLIFF COALS IN A PORTION OF THE PLATEAU COAL FIELD, ALABAMA

Tony D. Gray* and Robert A. Gastaldo. Dept. of Geology, Auburn University, AL 36849.

Coal petrographic relationships, aerial distribution, and the depositional history of the Upper Cliff coal seams (Pottsville) within the Plateau coal field of northeastern Alabama are poorly known because of a minimum of published data. These coal seams (No. 1 and 2) have been reported to represent high tonnage, low to medium volatile bituminous coal reserves. Preliminary coal petrographic analyses were performed on oriented coal block sections collected from three exposures along strike on Sand Mountain. Macropetrographic analyses on a volume percentage basis reveal that vitrain and clarain lithotypes predominate the coal seams with minor quantities of fusain occurring within the Upper Cliff No. 2 coal. Microscopically, five microlithotypes in various quantities are present within the coal seams (vitrite, argillaceous vitrite, fusite, carbargillite, and minerite). Lithologic and stratigraphic data gathered from exposures of the Upper Cliff coal interval have been the basis in an attempt to formulate a rock model explanation of depositional relationships. Lithologic sedimentary characters indicate paralic lower deltaic plain depositional environments without tidal influence and subsequent fluvialite derived sandstone deposition. Recognized depositional environments within the three-dimensional rock model include distal bar facies, distributary channel deposits, interdistributary bayfill sequences, coal forming marshes and swamps, crevasse splay deposits, and braided fluvial channel deposits.

FORESTRY, GEOGRAPHY, AND CONSERVATION

CARTOGRAPHIC LABS; SOLVING COMMON PROBLEMS

Pat A. Tamarin. Dept. of Geology and Geography, Univ. of Ala., Univ., AL. 35486

Cartographic labs come in all shapes, sizes and types, but all have common problems that must be solved. These problems cover all phases of cartographic work; from the designing of graphics, to the storage of supplies, to the training of workers. These problems can be solved in three different ways: 1) Wait, and hope to run into a solution accidentally, 2) Check books and written material for an answer, or 3) Contact another cartographic lab. Due to the common nature of many cartographic problems, and the increasing complexity of the field, an information exchange between labs is a solution that must be utilized increasingly today.

Abstracts

THE USE OF FARMLAND IN THE TENNESSEE VALLEY

H. A. Henderson, TVA; Noland Williams, TVA; and Billy Headden, SCS

Classifying land for management has advanced during the past few years. Prime farmland and Land of Statewide Importance are two terms that have become standard--but not well understood. This report indicates the relative value of prime farmland in producing income and food. Prime farmland is best suited for crop production and available for that use.

Cost of production varies with class of land: Corn on prime land costs \$1.00 per bushel, additional farmland of Statewide importance \$1.13, other suitable farmland \$1.56, and marginal \$2.55 compared with long range price of \$2.02 per bushel.

Prime farmland can be kept in continuous grain production with reasonable care without deterioration due to erosion. Production on other land must be carefully managed to avoid deterioration over time. The most intensive economic production within the national tolerance is:

<u>Land Class</u>	<u>Gross Income/A</u>	<u>Net Income/A</u>	<u>Bushels of Grain/A</u>
Prime	212	110	105
Statewide Importance	184	65	68
Other Suitable	126	26	19
Marginal	113	13	None

These relationships along with the growing scarcity of land, and increasing population makes prime farmland retention important for the future of the region and the world.

CASTE, OCCUPATION AND RESIDENTIAL CHOICE

William Reese Strong. Dept. of Geography, University of North Alabama, Florence, Alabama 35632.

The study is concerned with the urban spatial expression of the Telugu speaking population in residential areas of Bangalore, India. Bangalore is a polyglot city with Telugu speakers forming the third largest community. These people are culturally significant and are an important and sizeable labor force in the economy of the city. This research examined the degree and extent of adaptation of this immigrant community to the urban environment of Bangalore. It identified predominantly Telugu residential areas in the city, analyzed selected socioeconomic variables such as caste, occupation, education and income, and compared these socially significant areas to the residential ecology of Bangalore in particular and of urban India in general.

Abstracts

FARMLAND CONVERSION IN THE TENNESSEE VALLEY N. C. Williams, H. A. Henderson and Shelby Smith-Sanclaire

Less than one-fifth of the Tennessee Valley is prime farmland. Each year it loses 1 to 2 percent of its farmland to other uses. Prime farmland is often used, although over half of the region is suitable for development without using prime farmland.

The world is approaching limits of its ability to feed a growing population. Converting prime farmland here reduces that ability. The United States is one of few countries with a surplus of food. The Tennessee Valley is one of few regions that still has the option of preserving prime farmland.

Conversion is influenced by public actions. The National Agricultural Lands Study identified 90 Federal programs in 9 agencies including TVA with "major impact" on "the availability of land for agricultural production." TVA has withdrawn an equivalent of about 10 percent of the region's prime farmland and in one program alone is considering 21 sites--some of which consist of more than 2,000 acres of prime farmland.

A policy on prime farmland process should include open decision making, full disclosure, direct inputs from many citizens, and sensitivity to under represented groups like the rural, poor, and minorities. It should consider future food producing capacity, assume some costs private owners could not bear, encourage compatible multiple uses, and require development projects to pay mitigation costs or seek alternate locations. TVA has some good examples of multiple uses in managing the Kentucky reservoir.

THE ROLE OF GEOGRAPHICAL ANALYSIS IN CULTURAL RESOURCE PRESERVATION IN THE TENNESSEE-TOMBIGBEE WATERWAY IMPACT AREA

David C. Weaver. Dept. of Geology and Geography, Univ. of Ala.,
University, AL 35486

In North American Archeology in recent years there has been an increasing emphasis on regions rather than on individual sites as the major focus of research. This shift is reflected in the General Research Design developed by archeologists for cultural resource preservation in the Tennessee-Tombigbee Multi-Resource District. The research strategies developed reflect a variety of geographic concepts and techniques ranging from central place theory, and terrain analysis, to remote sensing and spatial statistical analysis. Particular emphasis was placed in the Research Design on the development of predictive models for site designation and analysis. The utility of geographic techniques for such model development is evaluated.

Abstracts

1836 CONSERVATION FORECAST FOR ALABAMA

Wilbur B. DeVall, President, Proxy Services, Ltd., Auburn, AL 36830

Early explorers of plant and animal life, such as William Bartram in Alabama, during the years 1773-1778, recorded much about the early plant associations and people. Little could be done in the name of conservation until Alabama was admitted to the Union in 1819. Most legislation dates from 1854 in the fields of timber and wildlife conservation. The Southern Literary Journal is a source of many stories pertinent to the conservation movement. Writers published on "The Pine Woods" in 1837 and "A Day at Chee-Ha" in the same year. The habits of people were described by other writers under titles such as "The Dirt Eaters." One of the first forecasts of things to come in the general area of conservation as it relates to forests is an oration delivered before the Society of the University of Alabama, at its first anniversary December 17, 1836 by Alexander B. Meek, a member of the Society. He summarized the situation as visualized by him as follows: "In the possession of all the natural resources, which contribute to make a State great and flourishing, Alabama stands pre-eminent. Her soil is as fertile as any portion of the Union! Her hills abound in mineral wealth! Her atmosphere is as pure as the sky of Italy! Her rivers roll in magnificent beauty and grandeur, through every portion of her territory, stretching their long arms, wherever the wants of agriculture or of commerce demand! ...These resources only want cultivation and development, to elevate our State to a high rank among her surrounding sisters."

METHODOLOGY FOR MODULAR FOREST HARVESTING SIMULATION MODELS

M. P. Padgett, G. S. Hines and D. B. Webster. Dept. of Industrial Engineering, Auburn University, AL 36849

A methodology is developed for employing statistical analyses to reduce the level of detail within a module without invalidating output. Economy in user input and computer requirements is sought by coding several versions of the module and comparing output. The technique is illustrated by reference to construction of a felling module, e.g. reduction in level of detail could mean a change in the method of estimating time consumed by some phase of the felling. Monte Carlo methods could be replaced by use of a regression equation to estimate drop-time and/or a simpler regression equation could be substituted for one with many terms employed to estimate shear-time. Procedures are developed for planning the randomization necessary for assuming independence, calculating the number of runs needed to allow the assumption of normality and testing homogeneity of variance. Analysis of variance and tests on means are recommended, if appropriate assumptions can be justified, to compare output of candidate modules to data gathered when test plots are harvested. Alternative techniques are proposed for use when various assumptions cannot be met. Results might suggest adjustments in the level of detail prior to reevaluation of the module, or might indicate the most economical of any acceptable description of the module.

Abstracts

LEGISLATIVE FORESTRY STUDY COMMITTEE UPDATE NO. 2

Wilbur B. DeVall, President, Proxy Services, Ltd., Auburn, AL 36830

Act. No. 79-711 of the Alabama legislature authorized a continuation of a study of forestry within the State. Using the recommendations set forth in the 1979 report, two updates have been prepared. The problems addressed have been wildfires, forest tree nurseries, energy wood, and needs of minority forest landowners. Funding for fiscal year 1982 was established for the Alabama Forestry Commission and the Extension arm, teaching program in forestry, and forestry research of Auburn University. Needs were combined for agriculture and forestry using a measure of current and projected productivity in each area. The 15-man committee utilized subcommittees as fact-finding bodies. Each reported back to the committee of the whole. When findings were approved by the majority, they were prepared for publication. All reports, including the 1981 update, were submitted to the Governor, Lt. Governor, and Speaker of the House along with all members of the legislature. The successive reports and updates serve the legislature as reference works in the area of forestry. The three senators and three members of the House of Representatives, along with nine appointed by the Governor or named in the Act, serve as a fact-finding committee of the legislative body in matters pertaining to forestry. The committee is continuing its work and will make further needs assessments of the forestry problems and issues as they pertain to making the forest lands of the State more fully productive.

HISTORIC PRESERVATION: SERENDIPITY OR PLANNING ?

KAREN K. CAGLE, *So. Cen. Ala. Development Comm., Montgomery, AL 36116*

It is safe to assume that over the next decade, unless historic preservation is made an integral part of some other activity, such as a downtown revitalization, housing renewal or economic development project, then it will fall to private individuals and groups to preserve many of our landmarks. Federal funds for preservation are being cut back now, and this foretells a trend for the 1980s. Therefore, we must set some policies to govern the selection of significant historic properties which will be competing for scarce preservation funds. We may choose to do nothing and leave preservation to serendipity, or we may choose a "first come, first served" policy. We may institute a preservation "triage" process, based on an inventory of properties and sites, which would prioritize items according to three questions: what do we have that 1) will survive if we do nothing to it; 2) will require action but may not be of such value to warrant the level of time or funds expended; and 3) will survive but only if we take direct action and has significant historic/cultural value? The example of the "Hickory Ground" Indian village site in Wetumpka, Alabama illustrates the counterclaims of serendipity and planning in the historic preservation process. The author makes a case for the need for planning and illustrates some methods to implement plans for historic preservation.

Abstracts

AN ECONOMIC ANALYSIS OF ENERGY CONSERVATION BUSINESSES IN DEKALB COUNTY, ALABAMA

Steven R. Sax and Barton N. Evans, DeKalb County Energy Management Program, Post Office Box 775, Fort Payne, Alabama, 35967.

In March 1977 the Tennessee Valley Authority initiated its Home Insulation Program for electrically heated or cooled households. The program provides interest free money for insulation, weather-stripping, storm windows and other conservation measures up to \$2,000 which can be paid back to TVA on customer's utility bills for a period of up to seven years. This report analyzes the effects of TVA's Home Insulation Program on the local economy of DeKalb County, Alabama. Ten firms providing energy conserving products and services were identified within the county. These firms had sales in 1980 totalling over \$1,000,000 and a combined payroll of approximately \$333,000. The results indicated that most of the energy saving products were purchased out of the county and that no training programs exist for individuals interested in insulation or conservation related employment.

PHYSICS AND MATHEMATICS

LAYERED OXIDE GROWTH ON PURE METALS

A. T. Fromhold, Jr., Physics Dept., Auburn Univ., Auburn, AL 36849.

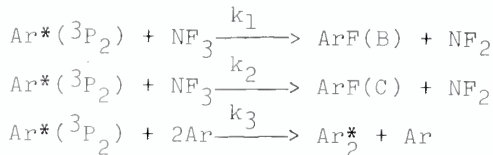
A general formulation for the simultaneous growth of any number of layered planar oxide phases on a pure metal under diffusion-controlled conditions has been developed. Four individual situations have been developed in detail, namely, situations in which the predominant mode of ion transport is by cation interstitials, cation vacancies, anion interstitials, or anion vacancies. The generalized formulation enables the determination of quasi-steady-state growth kinetics following step function changes in the experimental conditions such as ambient oxygen pressure or temperature. Numerical evaluation of the coupled growth equations for the individual phases is required to deduce the general predictions of the theory. In order to illustrate the type of results to be expected when utilizing microscopic physical theories for metal oxidation, specific application of these results is outlined for two different limiting cases in which the individual phases forming alone on the metal would grow parabolically under coupled-currents conditions, namely, the case of homogeneous-field parabolic growth and the case of parabolic growth under local space-charge-neutral conditions.

Abstracts

RATE CONSTANTS FOR THE FORMATION OF ArF^* AND Ar_2^*

Adila Dodhy, John R. Williams, Jr., and James E. Gaiser.
Dept. of Physics, Auburn University, AL 36849.

Work has been done to experimentally determine the formation rate constants for ArF^* and Ar_2^* using pulsed proton excitation of Ar-NF_3 and Ar-F_2 gas mixtures. The constants determined appear in the kinetics as follows:



Similar equations hold if F_2 is used instead of NF_3 . The analysis used in this experiment allowed the evaluation of $(k_1 + k_2)$ and k_3 . For the Ar-NF_3 system, $(k_1 + k_2)$ and k_3 have been found to be $1.5 \times 10^{-10} \text{ cm}^3/\text{s}$ and $1.2 \times 10^{-32} \text{ cm}^6/\text{s}$. The same constants for the Ar-F_2 system have been determined to be $2.7 \times 10^{-10} \text{ cm}^3/\text{s}$ and $1.8 \times 10^{-32} \text{ cm}^6/\text{s}$.

EXPERIMENTAL AND THEORETICAL NEUTRON CROSS SECTIONS AT 14 MeV

R.C. Harper and W.L. Alford, Dept. of Physics, Auburn Univ.,
Auburn, AL 36849

Activation techniques have been used to measure partial neutron cross sections at a neutron energy of $14.2 \pm 0.1 \text{ MeV}$. The present experimental results are $68 \pm 6 \text{ mb}$, $23 \pm 2 \text{ mb}$, $527 \pm 47 \text{ mb}$, $5.8 \pm 0.5 \text{ mb}$, and $130 \pm 12 \text{ mb}$ for the reactions $^{27}\text{Al}(n,p)^{27}\text{Mg}$, $^{58}\text{Ni}(n,2n)^{57}\text{Ni}$, $^{93}\text{Nb}(n,2n)^{92}\text{Nb}$, $^{93}\text{Nb}(n,\alpha)^{90}\text{mY}$, and $^{197}\text{Au}(n,2n)^{196}\text{mAu}$ respectively. The nuclei studied in this work were chosen due to isotopic abundancies, gamma-ray energies and intensities, half-lives and to allow a large mass range to be covered for verification of the theoretical calculations. The absolute cross sections were determined to an accuracy of 9% using a Ge(Li) gamma-ray spectrometer and the associated particle technique, with corrections for competing reactions, to determine the neutron flux. Previously measured cross sections are also given to indicate discrepancies and to allow comparison with present results.

Theoretical calculations based on the statistical, preequilibrium and direct reaction models were also performed. The agreement between the present experimental results and theoretical calculations indicate that these models are quite successful in predicting the neutron induced cross sections at 14 MeV.

Abstracts

DESIGN OF AN ISOTHERMAL PRIMARY HEAT SHIELD FOR THE STARPROBE SATELLITE MISSION

Alan Harmon and David L. Shealy, Physics Department, University of Alabama in Birmingham, Birmingham, Alabama 35294

The STARPROBE satellite mission is proposed to pass within four solar radii from the sun. A system of heat shields is necessary to prevent severe damage to the spacecraft during the close approach to the sun. Simple designs such as cones or planes for the primary heat shield give rise to hot spots with temperatures in excess of 3000°K at which the carbon-carbon primary heat shield material sublimates at an unacceptable rate. As an alternative approach, a differential equation for the surface of the primary heat shield has been formulated such that each element of area receives and emits the same amount of energy. The resulting surface temperature profiles are found to be approximately isothermal at a considerably lower temperature than the hot spots of the simple designs.

RATE OF ELECTRON HEATING IN A MULTIDIPOLE PLASMA

M. D. Haworth and R. E. Kribel, Dept. of Physics, Auburn University, AL 36849

Leung and Kribel¹ have performed an experiment in which monoenergetic test electrons are isotropically injected into a multidipole plasma. Solution of the Fokker-Planck equation shows that explanation of the experimental results in terms of test particle theory gives misleading results, and that electron-electron interactions alone cannot totally account for their results.

¹K. N. Leung and R. E. Kribel, Phys. Fluids 23, 1923 (1980).

CONSTRUCTION AND CALIBRATION OF MAGNETIC PROBES OF HIGH FREQUENCY RESPONSE

P. Beiersdorfer and E. J. Clothiaux, Dept. of Physics, Auburn University, Auburn, AL 36849

The calibration and construction of high frequency magnetic probes, used to measure rapidly fluctuating fields in a vacuum spark discharge, are discussed. Equivalent circuits are employed to analyze the response of the probes as a function of frequency and to determine the probe parameters. The effect of the geometry of the probe and its leads on the faithful reproduction of the magnetic fields is presented. The results of this analysis have been used to construct probes that give optimum response.

Abstracts

INDUSTRY AND ECONOMICS

MARKETING STRUCTURE OF THE AGRICULTURAL LIME INDUSTRY

Veronica A. Vitelli and W. Joe Free. Agricultural Marketing Resource Development Section, TVA, Muscle Shoals, Alabama 35660. William S. Stewart. University of North Alabama, Florence, Alabama 35630.

Market structure is the organizational characteristic that influences the nature of competition and pricing within a market. The market structure of the aglime vendors approaches monopolistic competition. In most counties, at least four aglime vendors spread lime and none were found that have a dominant share of customers. Aglime is a non-differentiated product but vendors can differentiate the spreading service they provide. Entry into and exit from the business is not restricted. Even capital requirements are low relative to requirements to enter in many types of business. Market conduct refers to patterns of behavior that firms follow within the market in which they operate. Market performance is the result of market conduct. The market conduct of most vendors regarding pricing policy is to meet competition and/or to cover cost plus a profit margin. Prices charged farmers for aglime spread on the field is near the cost of lime plus the cost of spreading. Prices that vendors pay for lime is usually about same in a given county. For example, calcitic lime cost vendors \$4.81 in Limestone County and \$4.50 - \$6.00 in DeKalb County depending upon the quarry supplying the lime. Dolomite lime cost vendors \$11.00 in DeKalb County. Most vendors charged \$4.00 per ton for spreading. They estimated that gas and oil cost \$2.00 per ton. Most did not estimate their total spreading cost. Fixed cost ranges from \$2.00 to \$2.50 per ton for most firms. That means most firms sell their aglime service at cost or less than full cost.

TOWARD A CONCEPT OF PROFIT ELASTICITY

A. Wayne Lacy and H. Dean Moberly, Department of Economics, Auburn University at Montgomery, Montgomery, AL 36193.

The primary thrust of economic theory as it relates to the firm's profit posture has typically been through the profit maximization concept. The approach taken to the relationship that exists between the profit level, whether maximum or not, and the firm's pricing decisions has been indirect. Price elasticity is related to total revenue changes and then compared with total cost changes. From a practical business approach, the firm is interested in what happens to profits for any pricing decision. This paper attempts to take a more direct approach to the profit-price relationship by merging these steps into a concept of profit elasticity. The basic relationships are explained and equations derived for the concept. A discussion of potential uses goes beyond the single firm analysis to an examination of the concept's potential as a possible partial explanation of relative market shares by industry.

Abstracts

DESIGNING A SYSTEM USING DATA FLOW DIAGRAMS

Rishi R. Chowdhury, Systems Analyst, Stockham Valves & Fittings, Birmingham, AL

Data flow diagram (DFD) is considered to be one of the most valuable systems analysis and design tool. It can illustrate not only the present manual or computerized system by flow of data but also clearly identify the complicated processes. Data flow diagram is a technique to illustrate a system by expanding each of the processes which are at the most general level to its most detailed level.

A system described by most expanded data flow diagrams clearly illustrates each of the processes, data stores, flow of data, source or destination of data and reports or documents printed.

In this paper, examples are chosen from a Human Resource System (example of business systems, in general) and a Population Genetics System (example of scientific systems, in general). A DFD is drawn at a most general level and then the processes are expanded so that each of the processes could be clearly illustrated and programmed. In case of more than one possible expansion of a DFD, one with less complexity and more efficiency is chosen.

ECONOMICS OF A SMALL WINERY IN ALABAMA

W. Joe Free and Veronica A. Vitelli. Agricultural Marketing Resource Development Section, TVA, Muscle Shoals, Alabama 35660.

Wine consumption in the United States doubled during the 1970's. About 80 percent of this increased consumption was with wine produced in the United States. Per capita consumption of wine in the United States has increased from .89 gallons in 1956 to 1.75 gallons in 1976. Alabama law gives a tax break to Alabama native wineries producing not more than 100,000 gallons. Wine produced in Alabama from locally grown grapes is taxed by the state at \$.05 per gallon. Potential for development appears great for small cottage type wineries operated as a part-time enterprise that sells all or part of its production direct to consumers. The paper identifies investment (excluding vineyard) and operating costs for several sizes of small wineries. Costs were found to vary with the size of the operation. Investment and operating costs per gallon decrease as the size of the winery increase--except for the 200 gallon winery which is basically for home production. Total cost for producing 5,000 and 50,000 gallons annually was \$13.21 and \$8.62 per gallon respectively. Total capital requirements for the first year ranged from \$6,265 for the 200 gallon winery to more than a million dollars for largest.

Abstracts

ECONOMIC GUIDELINES FOR A PROFITABLE AGRICULTURAL LIMESTONE ENTERPRISE

William S. Stewart. University of North Alabama, Florence, AL 35632.
W. Joe Free. Agricultural Marketing Resource Development Section, TVA,
Muscle Shoals, AL 35660.

A profitable retail lime market depends upon the ability of retail lime vendors to operate their firms profitably. A 1979 survey of eighty-seven lime vendors in the Southeast illustrated that most lime vendors were following poor economic practices in their lime operations which resulted in low or negative profits. The purpose of this paper is to show how a profitable agricultural retail lime enterprise is developed and how volume and good management practices affect costs.

SCIENCE EDUCATION

MARINE BIOLOGY EDUCATION IN N.AL--YOU'VE GOT TO BE KIDDING!

Joseph C. Thomas, School of Arts & Sciences, Univ. of N.Al., Florence, AL 35630

Alabama is a coastal state but the amount of coastline is extremely limited. Even with the limited coastal area, Alabama has an important marine related commerce and state dock system. As such the state should provide marine biology education for all parts of the state.

Marine biology education is provided for the state through the Marine Environmental Sciences Consortium (MESC) which is located at the Dauphin Island Sea Lab (DISL). The DISL is located at the east end of Dauphin Island in the facilities of the former U.S. Air Force Radar Base which was declared surplus property in the early 70's.

Membership in the MESC is limited to four-year colleges and universities within the State of Alabama. Currently 19 schools hold membership. Administration of the MESC and the DISL is accomplished through a Board of Directors (composed of the President from each member school), Executive Committee (representative group to carry out the affairs between board meetings), Program Committee (composed of the liaison officer from each member school), and the Executive Director in residence at the DISL.

A full program of marine biology education and research is provided at the DISL with summers devoted mainly to undergraduate courses and the academic year devoted to graduate study and research. Also, through the Discovery Hall Project, marine biology coursework is provided for H.S. biology students ranging from a week-end experience to a four-week course.

Alabama is not kidding -- marine biology education is available throughout the State through MESC.

Abstracts

RELATIONSHIP BETWEEN ENERGY DECISIONS AND PERSONAL ORIENTATION TO SCIENCE

Ove Jensen and Edith Miller

The issue of attitudes toward science and science related questions is a somewhat poorly studied area. In instructional planning and design, it is important to know to what degree the points-of-view and/or philosophical orientations of students have to do with their interaction with the instructional process. In this direction, the current study has been conducted.

Science educators generally classify a person's concept or view of science in the following categories: (1) factual or body of knowledge, (2) a process, or (3) technology or manipulation of the environment. Logically, one's view of science should have an effect on one's opinions or responses to science related questions. This specific study was designed to study the relationship of the view of science (as defined by the above three-part delineation) on a person's opinions about energy, a most pressing problem area in a science-related field.

The two instruments used in the study were (1) View of Science, developed by Henry Hardin and (2) Opinion Poll on Energy, developed by Marlin Simon and Ove Jensen. These two instruments were administered to 47 undergraduate college students enrolled in non-science majors. The data were then analyzed using multiple regression and discriminant analysis procedures, resulting in support of the general idea that view of science is significantly related to one's opinions on science related issues.

AREOLOGY: A PLANETARY SCIENCE PROJECT FOR MIDDLE SCHOOL SCIENCE

Ernest D. Riggsby, Columbus College, Columbus, GA 31993.

The project reported upon in this paper is an effort to design, test, and revise an in-depth unit on the planet Mars. The project is now approximately one-half completed. Areology is the scientific study of the planet Mars, excluding its earth-focused astronomy. The thrust of this emphasis is to assist students in the difficult task of translating their orientation and thinking to the Mars-centered point of view. The unit of study is subdivided into: history, biography, physical sciences, remote exploration, telemetry, and possible human on-sight exploration. The historical span of the unit is from Schiaparelli to beyond Viking 2; a little more than a century.

ENGINEERING/COMPUTER SCIENCE - THE BOUNDARY

William G. Bradley, Dept. of Electrical Engineering, The University of Alabama in Huntsville, Huntsville, AL 35899.

The boundary between Electrical Engineering and Computer Science is an area of considerable concern at most schools that teach both Engineering and Computer Science. Computer Science, Electrical Engineering and sometimes other engineering disciplines are rapidly expanding their course offerings in the area of microprocessors and microcomputers. All engineers and scientists, regardless of discipline, will be involved with applications of microcomputers in the future. However, some definition of the boundary between Computer Science and Engineering is necessary if duplication and competition is to be avoided. The traditional hardware vs. software distinction is inadequate when dealing with microcomputers. The hardware designer often must write his own applications software, and software designers must have a thorough understanding of the hardware. Computer based design uses the microcomputer as a component in digital systems and is an engineering area. However, applications programming is not clearly specified. Engineering courses must include some programming, and computer science courses must include some hardware. The distinction should consider the audience and ultimate goal of a particular course rather than its hardware vs. software content. Some overlap is necessary, but the programs should complement each other.

"FALCON FORCE: A MIDDLE SCHOOL PROGRAM FOR AEROSPACE STUDIES

Eleanor E. Eubanks, Muscogee County (GA) Schools; Dutchie S. Riggsby, Columbus College; and Ernest D. Riggsby, Columbus (GA) College.

The project under consideration in this report was a portion of the pilot study of a new aerospace studies kit which was designed for use in middle grade programs. This study was begun in a fourth grade science setting during the final semester of the 1980 academic year and is being continued with a fifth grade during the 1981 academic year. While the principal segment of the program centered in the science classes, it was also used in mathematics, art, language arts, and social studies. The design of the Falcon Force kit extends into these disciplines and more. Learning centers, individualized study and whole class involvement were the major approaches. Future plans include the use of Falcon Force materials as a regular part of the fourth and fifth grade programs at the elementary school in which the initial effort was undertaken.

Abstracts

USING PSEUDOSCIENCE IN INTRODUCTORY PHYSICS COURSES

Raiford M. Ball. Auburn High School, Auburn City Schools, Auburn, AL 36830.

Pseudoscience topics such as UFO's, the Bermuda triangle, and the ancient astronaut theories are often brought up as student questions in introductory physics courses. By emphasizing certain criteria for judging any item of supposedly factual literature, the beginning student can be taught to evaluate claims for himself. The basic criteria are a logical progression of ideas, internal consistency, documentation of facts, agreement with previously known facts, agreement with standard engineering practices, and agreement with known scientific laws. Student acceptance of the criteria can be evaluated by classroom discussions, an evaluative paper, a field project, and a laboratory experiment.

SOCIAL SCIENCES

JOHN HERBERT PHILLIPS: EDUCATIONAL PIONEER IN BIRMINGHAM

Mary C. Metzger, Dept. of History, Univ. of Ala., Birmingham, AL 35294

Honored as one of Birmingham's most influential citizens, John Herbert Phillips is recognized as the founder of the city's public school system. A closer look at his career, however, illuminates both his organizational skills and his inability to provide more equality in education than was allowed in Birmingham society as a whole. Phillips began his tenure as the city's first superintendent in 1883. Birmingham, only a decade old, possessed two schools, one each for blacks and whites. Both charged tuition since taxes did not provide sufficient support. Phillips secured additional financial support sufficient to supplement tuition, a charge he was able to abolish by 1910. Phillips built new schools, planned school curricula, hired teachers, and carried wide the banner of progressive education. As Birmingham grew, schools of annexed municipalities joined the Birmingham system. New revenue and personnel enabled programs for mentally retarded students, summer schools, and adult classes. Through the force of his personality and organizational acumen, Phillips forged a system of 53 schools by the time of his death in 1921. The system might be considered wholly progressive had it overcome the uneven handling of black students and female faculty. Equality in school employment policies began to evolve slowly during Phillips's tenure; however, balanced educational opportunities and facilities had to be sidetracked. Phillips would not willingly have jeopardized his position for such an effort. That the school system included blacks was, for that time, an immensely positive step.

Abstracts

PRESIDENT GETULIO VARGAS AND THE BRAZILIAN--UNITED STATES ALLIANCE DURING WORLD WAR II

Linda Williams Shabo. Dept. of History, Auburn University,
Auburn University, AL 36849

The relationship between the United States and the government of Gutulio Vargas was determined by the changing needs of the United States. Until the end of 1943 the American Government pursued a policy which supported Brazilian industrial and military development and guaranteed Brazil's hegemony in South America. This policy was designed to assure Brazil's cooperation in the war-effort. American aid made it possible for Vargas to maintain the support of the Brazilian military and other nationalistic elements whose good-will depended upon Vargas's ability to obtain American money, arms and technological assistance. When allied successes made Brazil less important to American defense plans, United States policy toward the Vargas Government changed. This change became increasingly evident after the summer of 1944. The United States refused to honor its pledges to Vargas and sought to secure his replacement by someone who was more amenable to American business interests. American refusal to support Vargas helped precipitate the military coup which removed Vargas from office in October, 1945.

BISHOP JOHN HOOPER; ENGLISH REFORMATION MARTYR

Joel L. Alvis, Jr., Dept. of History, Auburn Univ., AL 36849

John Hooper, Bishop of Gloucester, 1551-1553, was active in the English Reformation under Edward VI. He fled England to escape the religious conformity demanded by Henry VIII. After studying on the continent, primarily at Zurich in the 1540's, Hooper returned to England and assumed a leadership role in the Protestant faction of London. He was appointed to the bishopric of Gloucester in 1550 but refused to be consecrated in the traditional vestments. It was only after he was coerced that Hooper agreed to the traditional consecration. But later actions by the Church of England indicated that Hooper's stand had an effect. In the reign of Queen Mary he was deprived of his bishopric for being married clergy. Eventually he was executed for his Protestant heresies. Hooper's career is a case study in the parameters of religious change in a society where church and state are coterminous.

ROOT, HOG, OR DIE: THE CONDITION OF BLACK LABOR IN ALABAMA, 1870-1880

John B. Myers, Dept. of History, Columbus College, Columbus, GA 31993

In predominately agricultural Alabama, white economic interests relied heavily on cheap labor. The emancipation of slaves and governmental involvement conflicted with white financial interests and their desire to control black labor. But, employers' bargaining position was substantially improved when federal intervention ended. The discontinuation of the Freedmen's Bureau's role in labor affairs in 1869 reflected a change in federal policy which conferred the responsibility of maintaining compatible relations between capital and labor upon state government. This agency had represented a labor relations liaison between white employers and black employees who were placed in a position of direct confrontation after the Bureau withdrew. The U.S. Congress justified this removal by assuming that the pro-black Republican governments in the south had the capability to supervise labor relations. But in 1870, the election of a Democratic governor in Alabama, and increased Democratic representation in the state legislature reflected the erroneous assumption of the federal government. By 1874, Alabama Democrats permanently redeemed the state and embarked on a program based on the political, legal and economic interests of white Alabamians; frequently at the expense of black labor. Faced with a dismal political prospect and the federal policy of withdrawal, Alabama freedmen sought to improve their condition through black leadership and organizations. These attempts failed and black labor interests suffered even further by the nationwide economic adversity which began in 1873. By 1880 Alabama black laborers' vulnerability and dependence upon white employers closely paralleled the master-slave relationship of antebellum days.

THE SOCIAL AND POLITICAL THOUGHT OF JUAN DE VALDES

Daniel A. Crews, Dept. of History, Auburn Univ., Auburn, AL 36830

In the first half of the sixteenth century the social, religious and political structure of Western Europe came under attack from within just as the Ottoman Turks were making their greatest historical effort to extend their European conquests. As an imperial agent for Charles V Juan de Valdes tried to gather support for a general Church Council to reform and reunite the universal Church. His reform ideas were not limited strictly to religion. He opposed the trend toward national centralization and saw it as a threat to the political function of the Holy Roman Empire. Valdes' emphasis on toleration, personal experience and humility was part of his attempt to reshape social values. These doctrines were the connecting threads between his political and religious life. Valdes believed that internal reform was essential to the defense of Western Christendom from the Turks and Islam.

Abstracts

HEALTH SCIENCES

Effect of liposomes containing α -tocopherol on blastogenesis in bovine lymphocytes.

Michael W. Fountain and Ronald D. Schultz, School of Veterinary Medicine
Auburn University, AL 36849.

Bovine peripheral blood lymphocytes were obtained by Ficoll-Hypaque density centrifugation. The effects of α -tocopherol (α -T) (incorporated into the liposome bilayer) on the response of bovine lymphocytes to phytohemagglutinin (PHA) were examined using fluid (phosphatidylcholine (PC) and dimyristoylphosphatidylcholine (DMPC)) and solid (dipalmitoylphosphatidylcholine (DPPC)) multilamellar liposomes. Results indicate that α -tocopherol is able to reverse the suppression exhibited by PC liposomes and is able to enhance the response exhibited by DMPC and DPPC liposomes.

The effect of preincubation of lymphocytes with liposomes prior to the addition of PHA exhibited a time dependent suppression of blastogenesis which was reversible for PC: α -T (1:1) liposomes but not for PC liposomes. The effect of PHA preincubation with lymphocytes prior to the addition of liposomes exhibited a time dependent, reversible suppression of blastogenesis for PC: α -T (1:1) liposomes but not reversible for PC liposomes. The effects of phospholipid concentration on the blastogenic response to PHA exhibited a concentration dependent suppression from 1 to 3 μ moles phospholipid/ml which was reversible, at a concentration of 4 μ moles phospholipid/ml.

A SOLUBILIZABLE GEL FOR THE PURIFICATION OF HISTONES

R.D. Faulkner, R. Carraway†, and Y.M. Bhatnagar, University of South Alabama, Department of Anatomy, Mobile, Alabama 36688 and †University of Massachusetts, Department of Physiology, Worcester, Massachusetts 01605.

Histones from calf thymus and mouse testis have been fractionated on 17% acrylamide gels containing 0.19% bis-acrylylcystamine (BAC) and 2.5M urea at pH 2.7. Polyacrylamide gels which contain BAC, a cross-linking agent with disulfide bonds, can be solubilized in presence of 2-mercaptoethanol (3.0M) or cysteine (0.8M) at pH 8.3. Polymerization is carried out at 40°C and in presence of 6.5-7.5% tetramethyl ethylene diamine (TEMED) at pH 8.3. Gels formed at lower pH or TEMED concentrations are not soluble. Pre-electrophoresis with acidic buffers changes the gel pH to 2.7. Resolution of histones in BAC-acrylamide gels is comparable to that in bis-acrylamide gels. Preparative isolation of histones is facilitated with soluble gels. BAC-acrylamide gels containing detergents can be also solubilized and should prove useful for the fractionation and subsequent isolation of proteins. (Supported in part by USPHS NIH Grant HD-12744.)

FRACTIONATION OF ACID HYDROLASES ON CIBACRON BLUE-SEPHAROSE

J.T. Conary, J.N. Thompson, and L. Rodén. Lab. of Med. Genetics, Dpt. of Biochem., and DRTC, Univ. of Ala. in Birmingham, Birmingham, AL 35294

Cibacron Blue 3GA is one of several textile dyes which have proven useful as ligands in the purification of enzymes by affinity chromatography. Elution from the affinity matrix is commonly carried out with substrates or inhibitors, or by increasing the ionic strength of the buffer; however, the influence of the pH of the eluting buffer has not been systematically investigated. In the present study, the effect of pH on the elution profiles of the following eight lysosomal hydrolases has been determined: arylsulfatase A and B, N-acetyl- α -D-glucosaminidase, N-acetyl- β -D-hexosaminidase, β -D-galactosidase, α -L-fucosidase, β -D-glucuronidase, and heparin N-sulfate sulfatase. A partially purified preparation containing these enzymes was obtained from an extract of bovine testis by precipitation with ammonium sulfate at 40% saturation, and this material was applied to a column of Sepharose-bound Cibacron Blue which was subsequently eluted with 0.1 M citrate-phosphate buffers increasing stepwise in pH from 4.5 to 8.0. This approach permitted the separation of the eight enzymes into four groups. Arylsulfatase A and B were eluted at pH 4.5; N-acetyl- α -D-glucosaminidase, N-acetyl- β -D-hexosaminidase, and β -D-galactosidase were eluted at pH 7.0; α -L-fucosidase, β -D-glucuronidase, and a minor proportion of the N-acetyl- β -D-hexosaminidase emerged at pH 8.0; and heparin N-sulfate sulfatase and some of the α -L-fucosidase and β -D-glucuronidase were eluted with pH 8.0 buffer containing 1 M NaCl. These findings demonstrate that chromatography on Cibacron Blue-Sepharose is valuable as an early step in the purification of lysosomal hydrolases and that selective elution may be accomplished by varying the pH of the eluting buffer.

Phillip A. Fields, University of South Alabama, Department of Anatomy, Mobile, Alabama 36688 and Lynn H. Larkin, University of Florida, Department of Anatomy, Gainesville, Florida 32610.

Relaxin was purified from human term placentas by gel filtration (Sephadex G-50 fine) and isoelectrofocusing. The human relaxin was similar to porcine relaxin with a molecular weight of approximately 6000 and an isoelectric point greater than 10. The purified human relaxin showed a reaction of identity to porcine relaxin when crossreacted with anti-serum to porcine relaxin. Although like porcine relaxin, human relaxin inhibits spontaneous contractions of the mouse uterus and promotes growth of the mouse interpubic ligament, the specific activity of human relaxin was lower than porcine relaxin (15 units/mg versus 3000 units/mg, respectively). Immunocytochemical localization of relaxin in the term placenta demonstrated the hormone to be present in the peripheral cytotrophoblast cells. Porcine relaxin antiserum was utilized in these studies. There was no staining of the cells when normal rabbit serum or porcine relaxin antiserum preincubated with porcine relaxin were utilized. These studies clearly indicate that human relaxin is present in extraluteal tissue and is present during the last stage of pregnancy.

PHOSPHODIESTERASES OF HUMAN POLYMORPHONUCLEAR LEUKOCYTES

Janet L. Legendre and Harold P. Jones. Dept. of Biochemistry, Univ. of South Alabama College of Medicine, Mobile, AL 36688.

In light of the importance of cyclic nucleotides in the regulation of many of the bactericidal activities of human polymorphonuclear leukocytes (PMNs), we have examined the phosphodiesterase (PDE) composition of these phagocytic cells. High speed supernatant fractions prepared from isotonic homogenates of human PMNs were chromatographed on DEAE-cellulose. This procedure revealed the presence of at least three separable forms of cyclic nucleotide PDE. When each of the three forms was tested for stimulation by calcium and calmodulin, no detectable activation was observed. However, chromatography of each of the three peaks on calmodulin-Sepharose revealed that Peaks I and II were partially retained by the column in the presence of calcium. In each of these cases the PDE not retained by the column as well as that subsequently eluted with EGTA was found to be activated at least five-fold by calcium plus calmodulin. Furthermore, the activation was determined to be sensitive to inhibition by phenothiazine drugs which are potent calmodulin inhibitors. These results suggested that an inhibitor of calmodulin-dependent activation of PDE, present in the DEAE-fraction, was removed by chromatography on calmodulin-Sepharose. Aliquots from Peak II were examined for their ability to inhibit calmodulin-dependent activation of bovine brain PDE and were found to potentially inhibit this activation. Therefore, there appears to be both calmodulin-sensitive and insensitive forms of PDEs in the human PMN and an endogenous inhibitor of the calmodulin-sensitive activation of PDE. (Supported in part by an intramural grant from the Univ. of South Alabama College of Medicine.)

IDENTIFICATION OF A CALCIUM-STIMULATED ALKALINE PROTEASE IN THE NEMATODE *TURBATRIX ACETI*

Michael J. McGuire and Roger S. Lane. Dept. of Biochemistry, Univ. of South Alabama, Mobile, AL 36688.

A new alkaline proteolytic activity that hydrolyzes [*methyl*- ^{14}C]globin to acid-soluble fragments has been detected in the free-living nematode *Turbatrix aceti*. This protease was isolated from the 100,000 x g supernatant of *T. aceti* extracts by gel exclusion and DEAE-cellulose ion exchange chromatography. The partially purified enzyme is most active between pH 8.5 and 9 and is apparently of high molecular weight as determined by its elution behavior upon gel filtration on a column of Sepharose 4B. The hydrolysis reaction is stimulated by Ca^{2+} ions and inhibited by excess EGTA or EDTA; the reaction rate is maximal at 4 mM CaCl_2 . Mg^{2+} and Cu^{2+} also increase proteolysis but less effectively than Ca^{2+} . Ba^{2+} is ineffective in substituting for Ca^{2+} while Mn^{2+} , Zn^{2+} , Co^{2+} , Fe^{2+} and Ni^{2+} all show an inhibitory effect on protease activity. No effect of calmodulin (Ca^{2+} -dependent regulator) on the globin-degrading activity of the enzyme could be demonstrated. The functional significance of this Ca^{2+} -activated alkaline protease is unknown. (Supported by NIH grant AG 01002.)

INFLUENCES OF INTRARENAL HORMONES ON RENAL HEMODYNAMICS

Margaret L. Till, L. Gabriel Navar, and Phil Youngblood. Dept. of Physiology and Biophysics, 727 CDLD, University of Alabama, Univ. Station, Birmingham, Alabama 35294

The roles of the renin-angiotensin system and renal prostaglandins in mediating the renal vasodilator response to agents which block the renin-angiotensin system were studied. Clearances were performed in anesthetized dogs under control conditions and following prostaglandin synthesis and converting enzyme inhibition. Indomethacin, a prostaglandin synthetase inhibitor, administered i.v. at a dose of 5 mg/kg BW consistently and significantly decreased renal blood flow (RBF, $3.93 \pm .40$ vs. $3.11 \pm .28$ ml/min·g kidney weight) while raising mean systemic arterial pressure (MAP, 117 ± 6 vs. 130 ± 4) when compared with control values. The change in RBF in combination with a slight decrease (3%) in glomerular filtration rate (GFR) resulted in an increase in the filtration fraction ($.372 \pm .040$ vs. $.471 \pm .065$); indomethacin also tended to lower sodium and significantly lowered potassium excretion. Captopril (prime: 1 mg/kg BW and infusion: 1 mg/kg BW·hr, i.v.), an inhibitor of converting enzyme, when given after indomethacin returned MAP and RBF to control levels, while GFR rose significantly above control levels ($.802 \pm .065$ vs. $.963 \pm .061$ ml/min·gm). Electrolyte excretion returned to pre-indomethacin levels following captopril. These results suggest that under these experimental conditions the renal vasodilator effect of captopril is associated with if blockade of the renin-angiotensin system or another of its effects and is not due to prostaglandin-induced vasodilation.

IS N,N-DIMETHYLTRYPTAMINE AN ENDOGENOUS HALLUCINOGEN?

J.M. Beaton and P.E. Morris, Neurosciences Program, Univ. of Ala. in Birmingham, Birmingham, Ala. 35294.

Much interest has centered around the search for an endogenous hallucinogenic agent which might serve as the psychotoxin in schizophrenia. Many compounds have been suggested as this psychotoxin, one such compound is N,N-dimethyltryptamine (DMT), a very short acting hallucinogen. Studies in humans have shown that DMT does occur in cerebrospinal fluid, but not differentially in normal control subjects and schizophrenics (Smythies et al., 1979, Biol. Psychiat., 3, 549). However, DMT may just serve as a trigger in the precipitation of the psychosis. In the studies on the rat to be presented here, we have examined the effects of stress on the brain DMT levels and have measured the uptake and metabolism of exogenously administered deuterated DMT. This deuterated DMT is sequestered in the synaptosomes of these rats. The exogenously administered DMT is metabolized to the same products as the endogenous DMT. Time course studies have shown that the peak brain levels of the injected deuterated DMT correspond to the behavioral disruption seen after DMT administration. Stress increases endogenous DMT levels and DMT may be one of the brain's stress signals. In summary, DMT occurs in rat brain, is synthesized and metabolized in brain and appears to have a function. Thus, although DMT is an endogenous hallucinogen, its role in schizophrenia has yet to be defined. Supported in part by the Alabama Consumer Fund.

Abstracts
MORAL REASONING OF BACCALAUREATE NURSING STUDENTS

Janet S. Awtrey, School of Nursing, Univ. of AL in Birmingham, Birmingham, AL 35294

This study assessed the moral reasoning of baccalaureate nursing students and determined if students perceived school-related events or other life events as affecting moral reasoning. The Defining Issues Test (DIT) and a Life Experience Questionnaire were used in data collection. Kohlberg's theory of cognitive-moral development was the theoretical framework. The study was conducted over a span of 13 months. Data were collected at three intervals corresponding with the completion of the first sophomore clinical nursing sequence and the first junior and senior clinical nursing courses respectively. The DIT was administered at each of the specified periods and Life Experience Questionnaire at the final period. Thirty-two of the original 74 participants progressed uninterruptedly through the curriculum and adequately completed the DIT. The P percent score and the D score of the DIT were used to assess moral reasoning. A Life Experience Questionnaire was administered to assess whether students perceived school-related events or other life events as most affecting their reasoning. Findings from the study based on P percent scores led to the conclusion that the participants preferred principled moral reasoning much as do other college students. Respondents as a group did not experience change in moral reasoning as indicated by D scores. They regarded events other than school-related events as most affecting moral reasoning. Recommendations for future studies dealt with nursing students, nurse educators, and other health care providers.

THE COMBINED EFFECTS OF FLURAZEPAM AND NICOTINAMIDE UPON SLEEP

Connie Robinson and G. Vernon Pegram, Neurosciences Program, University of Alabama in Birmingham, Birmingham, AL 35294.

Nicotinamide (Vit. B₃) has been reported to bind at the benzodiazepine receptor site. To determine whether nicotinamide (NA) when given with a benzodiazepine (Flurazepam) would augment, antagonize or change in any other way sleep in mice, groups of animals were implanted with cortical electrodes for monitoring sleep. Both an acute and a chronic study were undertaken. Baseline data were obtained on animals in the acute study. Then on days 1-5 following baseline they were given either Flurazepam (Flu) alone or Flu and NA, 1 mg/kg and 500 mg/kg respectively. EEGs were recorded on days 1, 3 and 5 of drug injection. Recovery EEG was obtained 2 days following withdrawal of all drugs. There were no significant differences between the groups nor within the groups when experimental days were compared with baseline days. On recovery there appeared to be a rebound increase in SWS and a decrease in awake. All animals in the chronic study were injected with NA, 500 mg/kg, for 21 days prior to the implantation of cortical electrodes. After recovery from surgery they were begun on i.p. injections of Flu, 500 mg/kg while NA injections, i.p., were continued. Again, data were collected as above. Awake decreased on day 1 and gradually increased significantly through day 5. SWS showed the opposite trend. These data demonstrate no significant augmentation of the effects of NA upon the quality and/or quantity of sleep.

Abstracts

ESSENTIAL CONTENT IN MASTER'S DEGREE PROGRAMS IN NURSING

B. Jeanette Lancaster. School of Nursing, University of Alabama, Birmingham, Alabama 36830

Master's degree programs accredited by the National League for Nursing in July, 1978, were asked to respond to the following questions: What is currently being taught as essential content in your program? What do you think should be taught? For each of the content areas required of all students, what cognitive behavior is expected? What cognitive level should be expected for each content area taught? Consistency was examined to look at differences in what was actually being taught as compared to what faculty believed ideally should be taught. The study tool was a content inventory designed to elicit from respondents their perceptions of the real and ideal essential content, the extent of congruence between the two, and the expected cognitive behaviors of students. Data were treated by descriptive interpretations and simple rank order correlation. Results indicated that over 75% of respondents agreed that research, nursing process, health care delivery system, nursing theory, individual assessment, health wellness, illness, evaluation, decision making, accountability and interpersonal relationships were actually required in their program. Of these areas, 75% of the respondents agreed that the first four should ideally be required. Other ideally required content areas in the upper quartile included: change, communication, group dynamics, both political and legislative issues, culture-ethnicity, and ethics and health. The content preferences move from an individual orientation in actually required to a system oriented focus on change in the ideal categories.

MARKETING COMMUNITY MENTAL HEALTH CENTERS SERVICES

I. Wade Lancaster. School of Business, and B. Jeanette Lancaster, School of Nursing. University of Alabama, Birmingham, Alabama 35243

The development of community mental health centers as a significant contribution to the care of mentally ill people has occurred amidst controversy and criticism. Legislation providing funds to centers has been restrictive in that services were stipulated for all centers regardless of community needs and characteristics. New legislation in 1980 set up guidelines for flexibility and creativity in developing community mental health services. Will centers continue doing "more of the same" or will new community-oriented programs be developed? The application of a marketing framework for program development offers a model for developing programs based on consumer needs. Such an approach determines what the public perceives as its needs in order to develop plans to meet these needs. As such, marketing provides a way to examine, predict, plan, implement, and evaluate the exchange process between provider and consumers. Marketing uses a problem solving approach which includes: recognition of need, community analysis (community attitudes, services and resources available, identification of the target market and market segmentation), evaluation of alternatives, decision choice, and evaluation of the decision. Developing the market mix includes four planning variables: product, price, promotion, and physical distribution policies. While these variables are like those in classical business activities, unique applications are made in the area of community mental health.

Abstracts

Variables Related to Principled Moral Judgment of Nurses

Ann Estes Edgil, Univ. of Al. in B'ham. School of Nursing, B'ham, AL 35294

The research was intended to determine if educational preparation and selected variables in the environment of senior nursing students and practicing nurse are related to the principled level of moral judgment. According to cognitive developmental theory of moral judgment, which served as the theoretical basis, mental structure results from the patterning of the interaction between the organism and the environment rather than a reflection of innate patterns in the organism or patterns of events in the environment. An investigator constructed profile was used to collect data that included age, sex, educational preparation, a course in ethics, professional organization membership, length of practice, area of practice, and level of practice. The Defining Issues Test was used to assess levels of moral judgment. The t-test and multiple regression were used for data analysis. The overall significance of the full model as predictor variables for the principled level of moral judgment was statistically different from a null model with no predictor variables. A significant difference was found between students and nurses in the principled level of moral judgment. Stage 5A score (principled) mean was higher for nurses than for students. Since research has yet to clarify the specific environmental variables related to development of moral judgment, research is needed on the effect of environmental stimuli at different periods of development. Also, longitudinal investigation is necessary to determine the degree of development that occurs during educational and subsequent nursing practice experience.

PSYCHOLOGICAL ASSESSMENT OF PHYSICAL THERAPY STUDENTS DURING AN ACADEMIC YEAR. K.T. Francis and C. Adams. Division of Physical Therapy. University of Alabama in Birmingham, Birmingham, AL 35294

The process of physical therapy education can be a highly disconcerting experience. At no time is this more evident than in the first year of study in which the student is faced with an intense, concentrated program of study, generally slanted towards the basic sciences rather than the clinical sciences. The overwhelming amount of material to be absorbed, lack of free time, the pressures of examinations, and the discrepancies between expectations and reality all can be anticipated to bring psychological stress (used here as synonymous to feelings of anxiety, hostility, and depression). The present study was designed to quantify perceived stress in the various class levels throughout one academic year (30 weeks). The subjects were 45 UAB physical therapy students (physical therapy assistant students $n = 19$; junior physical therapy students $n = 19$; and first year master students $n = 7$). Assessments of mood and feelings were evaluated weekly using the State-Trait Anxiety Inventory and the Multiple Affect Adjective Checklist. Multiple Anthropometric measurements were taken quarterly. Peaks of anxiety, hostility, and depression and lean body weights were correlated with routine academic events such as exams, and schedule assignments throughout the academic year. This study is important in regard to curriculum planning and revision, especially during these times of change as programs consider alteration from a baccalaureate curriculum to a master's curriculum. This data set provides another perspective in this consideration and evaluative process.

Abstracts

1,100 Alabama Runners: Their Addiction to Exercise

Kathleen C. Brown. School of Nursing, University of Alabama in Birmingham, Birmingham, Alabama 35294. Jack Hataway, Glenda Barnes, Helen Hunter, and Patty Clark. Preventive Medicine. University of Alabama in Birmingham, Birmingham, Alabama 35294.

This study investigated reasons why joggers participate in running. Research is needed to understand factors which predispose individuals to pursue vigorous lifestyles. Therefore, the purpose of this research was to investigate joggers' reasons for involvement in running and whether they consider themselves addicted to exercise. A sample of more than 1,100 Alabama residents who jog completed questionnaires. The instrument measured participation in jogging, previous participation in varsity sports, perceived addiction to exercise, estimates of work exertion and health status, and selected health behaviors. Preliminary results on 938 subjects, over three-fourths males, are presented in this report. Frequencies and percentages as well as content analysis were used to analyze the data. Approximately 90% of the subjects indicated they jog because of a concern about health and because of feeling good after exercise. Three-fourths of the group reported concern about weight and appearance as reasons for jogging while one-half responded that they jog because of a concern about heart disease. In addition two-thirds of the subjects indicated they jog because they feel good while exercising. A similar proportion considered themselves addicted to exercise. Subjects attributed this to (1) a desire for pleasurable consequences including a good healthy feeling and a sense of accomplishment, and (2) a desire to avoid unpleasurable consequences of not exercising such as sluggishness, irritability, and guilt.

PRIMIPARA'S REACTIONS TO USE OF ELECTRONIC FETAL MONITORING

S. Benshoof and N. Keller*, School of Nursing, University of Alabama in Birmingham, Birmingham, AL, 35294

Because of the recently increased use of electronic fetal monitoring (E.F.M.) during labor, many women may not be receiving adequate prenatal orientation to its purpose and use. Inadequate orientation may cause increased anxiety and stress in women during labor. Lack of adequate research describing women's reactions to E.F.M. in current literature led the investigators to design a descriptive study of primipara's reactions to their orientation and use of E.F.M. during labor, and their suggestions for change. A one phase questionnaire for data collection was adapted from a prenatal and postpartum tool used by Brasted, Daley, and Calhoun for unpublished doctoral research. (1980, W. Va. Univ.) It measures behavioral, situational, cognitive, and sociodemographic variables. Fifty-three subjects found to meet criterion measures had participated by January, 1981. Data collected was partially analyzed, and selected findings reported in simple percentage form. Multiple regression techniques will be used for final data analysis. Findings could be significant for helping nurses improve the quality of E.F.M. orientation and implementation. (Supported in part by the Sigma Theta Tau Seed Grant, Nu Chapter, School of Nursing, University of Alabama in Birmingham, Birmingham, AL, 35294.)

Abstracts

ASSOCIATION PATTERNS OF HUMAN NUCLEOLAR ORGANIZER REGIONS

J.L. Smith, W.H. Finley, and S.C. Finley. Dept. of Medical Genetics Univ. of Ala. in Birmingham, Birmingham, AL 35294. W.M. Howell.* Dept. of Biology, Samford Univ., Birmingham, AL 35209.

The phenomenon of chromosome satellite association may be a causative factor in meiotic nondisjunction (Ferguson - Smith and Handmaker 1961). The cytological basis for this observation may actually be with the stalk which connects the satellite and the p arm. The stalks are the Nucleolar Organizer Regions (NORs) which stain with AgNO_3 if actively transcribed during interphase. Chromosomes may be connected to one another at the stalk as evidenced by silver grains deposited on and between NORs.

The characteristics of chromosome NORs were examined in a control population of both males and females. An association complex was defined as any group of two or more chromosomes whose NORs were connected with silver grains. The number of NORs per cell ranged from 5-10 with each individual having a characteristic mode. The majority of cells had 0, 1, or 2 association complexes which usually contained 2 chromosomes. The chromosomes entered into association in a non random manner both in the individual and in the total sample. In general, chromosomes 21 and 22 associated more frequently than 13, 14, and 15; chromosome 15 was found in complexes more often than 13 and 14. The particular pairings also seemed to be non random as 21-22 and then 15-22 were more common than others.

In the future, these results will be compared to those from parents of children with Down's Syndrome to determine if there is any correlation between satellite association and the risk for having a trisomic child.

EVIDENCE FOR A LEUKOCYTOLYSIN PRODUCED BY VIBRIO VULNIFICUS (LACTOSE POSITIVE VIBRIO)

C. Dees*, M.W. Fountain, and R.D. Schultz, School of Veterinary Medicine, Auburn University, AL. 36849.

An extracellular factor produced by Vibrio vulnificus (lactose positive vibrio) was found to lyse mixed populations of human and mononuclear cells. Canine macrophages, peripheral blood leukocytes, and thymus derived cells were non-specifically lysed by the leukocytolysin. The leukocytolysin was inactivated when heated for 15 minutes at 100 degrees C.. The leukocytolysin appeared to be a protein with an apparent molecular weight of less than 200,000 daltons.

Abstracts

PERCEIVED SOURCES OF STRESS AND COPING STRATEGIES IN PHYSICAL THERAPY STUDENTS. K.T. Francis and D.C. Naftel. Division of Physical Therapy and Department of Biostatistics. University of Alabama in Birmingham, Birmingham, AL 35294

The professional educational process can be a psychologically stressful experience (psychological stress defined as feelings of anxiety, discomfort, tension, or distress). Academic pressures associated with the study of difficult material and long hours of classroom and clinical practice combine to intensify psychological stress associated with pressures of college life. Physical therapy (PT) is an example of a professional educational process in which the educational preparation involves an arduous course of study that is intense and demanding. However, the perception of the sources of stress and coping strategies of the students enrolled in a PT curriculum has not been delineated. In order to study stress and coping factors in PT students, two one page questionnaires that had been field tested for reliability, were administered to 72 PT students (mean age 22½). One questionnaire assessed "stress factors" (SF) in the students; the other questionnaire assessed "coping factors" (CF) of the students. The SF and CF questionnaire contained 27 and 21 items respectively. Either stress or coping scores were obtained for each item. A mean stress and coping factor score was calculated and sources of stress and coping strategies were rank ordered. The four areas perceived as the most stressful by all the students were related to the environment of PT education. These included exams and grades, quantity of difficult classwork, long hours of study, and lacking free time. The least stressful items included drug use, child care problems, alcohol use, and marriage problems. The primary means these students coped with stress included talking problems over with friends and relatives, analyzing the problem, and praying. The least used coping strategies included use of tranquilizers, sexual comfort, or seeking professional assistance.

A ROLE FOR SUPEROXIDE IN INTESTINAL ISCHEMIA

Ranjan S. Roy and Joe M. McCord. Dept. of Biochemistry, Univ. of South Alabama, Mobile, AL 36688.

Based on our studies, it appears that intestinal xanthine dehydrogenase in rats undergoes conversion from one enzymic form to another if blood flow to the tissue is compromised (ischemia). Under normal *in vivo* conditions the enzyme exists as an NAD^+ -reducing dehydrogenase (Type D), incapable of reducing molecular oxygen to the reactive superoxide free radical (O_2^-). During ischemia it is converted to a form able to react with O_2 as electron acceptor and hence exists as a superoxide-producing oxidase (Type O). This conversion from the dehydrogenase to the oxidase occurs extremely rapidly in the small intestines. Data indicate that 80-90% Type D to Type O conversion occurs within 5-10 sec. Proteolysis appears to be the major cause in the modification of this enzyme. PMSF, an irreversible serine protease inhibitor, partially prevents this rapid conversion from Type D to Type O. Dithioerythritol not only prevents but also reverses this conversion brought about by reduced blood flow. The substrate for xanthine oxidase, hypoxanthine, arises due to catabolism of adenine nucleotides in ischemic tissues. Thus, upon reperfusion (reoxygenation) of the tissue, xanthine oxidase (Type O) is able to reduce molecular oxygen to superoxide radicals which causes further damage to the ischemic tissues. Allopurinol, an inhibitor of xanthine oxidase, has been found to protect tissues from ischemic damage. (Supported in part by NIH grant AM-20527.)

Abstracts

EFFECTS OF SALINE ON THE DEVELOPMENT OF RENAL HYPERTENSION

Cynthia Ann Jackson and L. Gabriel Navar. Dept. of Physiology & Biophysics, 727 CDLD, Univ. Station, Univ. of Alabama, Birmingham, AL 35294

Experiments were conducted on two-kidney, one clip Goldblatt Hypertensive rats to assess the effect of addition salt intake on systolic blood pressure during the course of renovascular hypertension and to evaluate the influence of salt intake on renal function in renovascular hypertensive rats. Eleven days after the animals were clipped and given 0.9% saline or tap water to drink, a significant difference in the blood pressure was observed between the clipped rats ($n = 10$, $BP = 172.82 \pm 6.66$ mmHg) and the nonclipped rats ($n = 10$, $BP = 119.36 \pm 4.60$ mmHg). However, the addition of 0.9% saline did not increase nor decrease the blood pressure within each group during the course of the three week study. The urine flow and sodium excretion were higher in the hypertensive rats (27.29 ± 2.9 μ l/min and 2.36 ± 0.37 μ Eq/min) than the normotensive rats (14.13 ± 1 μ l/min and 1.05 ± 0.24 μ Eq/min). The saline-drinking normotensive rats exhibited greater urine flow and sodium excretion than the water-drinking normotensive rats. In contrast, the addition of salt intake in the hypertensive rats reduced the urine flow and sodium excretion. The glomerular filtration rate (GFR) of the hypertensive rats (1.02 ± 0.04 ml/min/g of kidney wt) was reduced when compared with the normotensive rats GFR (1.11 ± 0.04 ml/min/g of kidney wt). However, the addition of salt intake in the normotensive rats had no effect on GFR; whereas in the hypertensive rats, the GFR increased and approached values of the normotensive rats. These observations are consistent with the concept that the addition of salt which decreases renin levels may maintain an elevated blood pressure due to an inappropriate high level of sodium retention; thus insinuating an involvement of a more specific intrarenal mechanism.

MAPPING VIRULENCE ASSOCIATED WITH THE HERPES SIMPLEX GENOME

Wayne L. Gray, and John E. Oakes,* Dept. of Microbiology and Immunology, Univ. of South Alabama, Mobile, AL 36688.

Herpes Simplex Viruses (HSV) vary greatly in their neurovirulence for laboratory animals. The reason is unknown but virulence is known to be a genetic trait of some HSV strains. Studies are underway in our laboratory to determine which genes are associated with HSV pathogenicity. Parental HSV-1 and HSV-2 strains and recombinants were tested for their ability to cause a lethal encephalitis in mice upon inoculation into the left hind footpad. HSV-1 strain 17 was virulent with an LD50 of 3×10^5 PFUs. HSV-2 strain 186 was avirulent even when tested at 3×10^7 PFUs. An intertypic recombinant of these parental strains had virulence characteristics very similar to the HSV-1 parent. The data indicates that genes located between the 0.2 and 0.8 map site of the HSV-1 strain 17 genome are associated with virulence. The HSV-2 186 strain was lethal when inoculated into irradiated mice suggesting that the avirulence of this strain is due to an inability to evade host defense mechanisms. Further studies using intertypic recombinants indicate that virulence in irradiated mice is associated with genes located between map units 0.1 and 0.3 and/or between 0.6 and 0.8 on the HSV-2 186 genome. The mapping of HSV genes which determine virulence could be significant in designing anti-viral agents against proteins coded for by those genes.

DIABETOGENIC EFFECTS OF CHLOROZOTOCIN

G.L. Wilson. Dept. of Anatomy, Univ. of So. Alabama, Mobile, AL 36688
B.T. Mossman and J.E. Craighead. Dept. of Path., Univ. of Vermont,
Burlington, VT 05405

Epidemiological evidence indicates that environmental factors, in conjunction with genetic and immunological influences, play a critical pathogenetic role in insulin-dependent diabetes mellitus. N-nitroso compounds and their precursors are environmental pollutants and commonly are present in human food. In this study the N-nitroso compound, chlorozotocin (CLZ) was evaluated for its effects in insulin producing pancreatic beta cell monolayer cultures. CLZ was found to be toxic to beta cells at equimolar concentrations to those required using the known beta cell toxin streptozotocin (SZ). SZ is also a nitrosoamide. To determine whether CLZ was diabetogenic, 6-week-old male golden Syrian hamsters and CD-1 mice were injected intraperitoneally with CLZ at concentrations from 20 to 100 mg/kg body weight and blood glucose determined 2, 4 and 7 days later. Dosage dependent hyperglycemia (glucose concentrations > 180 mg/dl) developed after 2 days in hamsters receiving 30 to 60 mg/kg CLZ and mice receiving 50 to 100 mg/kg CLZ. Necrosis and degeneration of beta cells was prominent in hamsters and mice killed at intervals after inoculation, whereas alpha cells and acinar tissue were unaffected. Lesions were not observed in the heart, lungs or liver of these animals but extensive tubular necrosis was found in the kidneys of animals receiving the larger amounts of the drug. CLZ is currently used for human cancer chemotherapy. Concentrations of CLZ used in these studies are comparable to the dosages used in humans. The potential for a diabetogenic effect of CLZ in man remains to be determined. (This work was supported by a grant from the Kroc Foundation.)

ALTERATIONS OF CHLORIDE TRANSPORT IN THE FROG GASTRIC
MUCOSA, IN VITRO

Richard L. Shoemaker, Dept. of Physiology and Biophysics,
University of Alabama in Birmingham, Birmingham, Alabama 35294.

Chloride is transported from the serosal to the mucosal side of the gastric mucosa, in vitro, and the degree of stimulation of the proton pump alters the chloride transport rate. Anion transport can be studied under three conditions of acid secretion: no secretion (inhibited), basal (or spontaneous) or stimulated rate; compounds that alter chloride transport produce different electrophysiological responses under different acid secretion rates. When the mucosa is secreting acid the following compounds (added to serosal solution) produced these changes: DIDS reversed the transmucosal potential (P.D.) but there was no significant change in the resistance. Furosemide produced a slight change in the P.D. but adding furosemide after the addition of DIDS produced no further changes. After the acid secretion rate was reduced to zero by Cimetidine (1 mM), DIDS or furosemide reduced the P.D. by 50% but increased the resistance significantly. Ethacrynic acid reduced the P.D. to zero and significantly reduced the resistance. When the stomachs were secreting acid at a spontaneous rate the effects of the compounds were intermediate to the above responses.

Abstracts

REGULATION OF TRIOSE PHOSPHATE ISOMERASE TURNOVER IN SENESCENT *TURBATRIX ACETI*

Rajendra D. Ghai. Department of Biochemistry, University of South Alabama, Mobile, AL 36688

The triose phosphate isomerase (TPI) activity of the nematode *Turbatrix acetii* declines significantly (40-50%) with advancing age. Immunotitrations of extracts prepared from nematodes of various ages yield identical equivalence points, indicating that the observed differences in enzyme activity are due to changes in the amount of enzyme protein. To elucidate the mechanism by which aging influences the concentration of this isomerase, the relative rate of *de novo* TPI synthesis was examined in young (4-day old) and senescent (24-day old) animals using rabbit antibodies directed against purified enzyme. The anti-TPI IgG fraction used gave a single precipitin band in double-diffusion analysis and completely precipitated TPI activity from *T. acetii* extracts. Sodium dodecyl sulfate-polyacrylamide gel electrophoresis of radioactive immunoprecipitates isolated from nematodes maintained in media containing [³H]leucine for specified time intervals showed that the immunoprecipitates were free of contaminating proteins. The newly-synthesized enzyme in senescent *T. acetii* had the same subunit size as the M_r=26,000 subunit of the "young" isomerase. Incorporation of radioactivity into immunoprecipitable TPI proceeded at a rate which was 35-50% slower in 24-day old nematodes than in 4-day old animals. The data indicate that the reduced content of catalytically active TPI molecules found in old *T. acetii* results, at least in part, from a decrease in the relative rate of enzyme synthesis. (Supported by NIH Grant #AG-01002)

INCREASED INTRACRANIAL PRESSURE, SLEEP AND A METABOLITE OF NICOTINAMIDE

Connie R. Robinson, Neurosciences Program, University of Alabama in Birmingham, Birmingham, AL 35294.

In our labs it had been previously shown that nicotinamide (NA) injected i.p. over 14 days produced an increase in REM sleep. It was not known how this effect occurred so the 6-pyrido metabolite of NA, methyl-0-nicotinamide was chosen for study. Groups of mice were implanted with cortical electrodes and with a lateral ventricular cannula for intracerebral ventricular (icv) injections. After recovery from surgery data were collected on baseline and on experimental day 1 and 2. Approximately 7 hours of EEG's were obtained for each condition. One group of animals was given 1 mg/kg of the 6-pyrido compound, a second group received 2.5 mg/kg and a third group received matched volumes of 0.9% saline. There was a slight increase in SWS over baseline on both experimental days and a decrease in awake for those days over baseline. The changes in sleep were not due to the transient increased intracranial pressure since there was no change in sleep EEG following saline injections by the icv route.

Abstracts

PARENTAL SELF-CONCEPT, LOCUS OF CONTROL AND ASSESSMENT OF INFANT TEMPERAMENT

Phyllis Nichols Horns. School of Nursing, UAB, Birmingham, AL 35294

The purposes of this study were to determine if parental self-concept and locus of control are influential in parental perception of infant temperament and to ascertain whether mothers and fathers differ in perception of infant temperament. The study sample consisted of 30 mothers and 30 fathers of $3\frac{1}{2}$ to $8\frac{1}{2}$ month old infants who were normal, single births and had no chronic health problems. A demographic profile was completed for each parent using a structured interview. In addition, each parent completed the Tennessee Self-Concept Scale, Nowicki-Strickland Internal-External Control Scale for Adults, and Carey-McDevitt Infant Temperament Questionnaire. Frequencies, the chi square statistic, and multiple regression were used for data analysis. Mothers and fathers did not differ significantly in perception of infant temperament as measured by the Temperament Questionnaire. However, mothers and fathers were significantly different in their general ratings of infant temperament. Moreover, the general ratings revealed that 76% of mothers and 67% of fathers rated the infant as easier than average. A significant difference was found between the mother's questionnaire rating and her general rating of infant temperament. Self-concept and locus of control were not found to influence parental perception of infant temperament. However, maternal perception of infant temperament was found to be related to a multivariate combination of maternal age, race, socio-economic status, self-concept, locus of control; and infant sex, age, and ordinal position.

REVIEW OF VITAMIN C : CHEMISTRY, PROPERTIES AND MULTIPLE FUNCTIONS

Emmett B. Carmichael, Med. Center, U.A.B., Birmingham, AL.

This is a review of the properties and multiple functions of vitamin C and includes therapeutic uses of the vitamin in common colds, whooping cough, herpes virus, encephalitis, measles, chicken pox, mononucleosis, hepatitis, pressure sores, back pain, cervical carcinoma of the uterus, cancer, ocular alkali burns, barbiturate poisoning, lead poisoning, stress, ankylosing spondylitis, insect bite and snake bite.

Abstracts

CHARACTERIZATION OF ACTIVE CHROMATIN RELEASED BY DNAase I ACTION

Jim W. Gaubatz. Dept. of Biochemistry, Univ. of South Alabama, Mobile, AL 36688.

The most popular method of chromatin fractionation now uses micrococcal nuclease to shear chromatin prior to the separation of DNA into subsets of transcriptionally active and inactive sequences. DNAase I, on the other hand, is most commonly employed to degrade selectively DNA in an active chromatin structure. By coupling limited enzyme action with the large transcriptional capacity of mouse brain tissue, we have succeeded in isolating an active chromatin fraction following DNAase I digestion. The concentration of DNA sequences complementary to cytoplasmic poly-A⁺ RNA are approximately 10-fold more abundant in the active fraction than in total DNA which is similar to the greatest enrichment previously achieved with micrococcal nuclease. The DNAase I-solubilized active fraction contains a significant amount of DNA with a native chain length greater than 600 base pairs (bp) whereas DNA in active chromatin generated by micrococcal nuclease is only 140 bp. Electrophoresis on denaturing gels demonstrated that DNA in the active fraction was not substantially degraded compared to the other fractions. This suggests that the spacer DNA between nucleosomes is largely intact. Since spacer DNA is the primary binding site for histone H1, our observation that active chromatin obtained by the DNAase I method lacks histone H1 is direct evidence for protein replacement in gene activation. Therefore, it appears that chromosomal material derived from DNAase I-digested nuclei more clearly delineates the association of nuclear proteins with certain elements of structure. (Supported by an intramural grant from the College of Medicine, University of South Alabama.)

REGULATION OF INSULIN BINDING TO VARIOUS TISSUES

Joyce F. Haskell, Elias Meezan and Dennis J. Pillion, Dept. of Pharmacology, U.A.B., Birmingham, Alabama 35294.

The binding of insulin to membrane receptors is the first event in the process which eventually leads to accelerated sugar uptake and metabolism, increased protein synthesis and the inhibition or stimulation of a variety of intracellular enzymes in hormone-sensitive tissues. Insulin receptors have been studied in a wide variety of mammalian tissues, with considerable interest focused on adipose, liver and muscle cells, since these represent the primary site of insulin action. Recent advances have allowed the isolation of intact brain microvessels, seminiferous tubules and Leydig cells by selective sieving without recourse to harsh digestive enzymes. This report identifies for the first time the presence of specific insulin receptors in each of these tissues and compares them with adipocytes. Studies are also in progress to determine whether or not the addition of physiological levels of insulin to these tissues leads to an increase in the rate of D-glucose uptake.

HYPOPHYSECTOMY, THE OPIATES, AND PAIN IN THE RAT

V.A. Gonzalez*, C.L. Millican* and J.M. Beaton, Neurosciences Program, Univ. of Ala. in Birmingham, Birmingham, Ala. 35294.

Hypophysectomy has been reported by several groups of investigators to produce a dramatic relief of intractable pain in many cases of patients with widespread metastatic cancer. One possible mechanism which has been suggested for this relief from pain has been a change in the level of the endogenous opiate peptides of the pituitary. The present study was carried out to examine the effects of intraperitoneal injections of saline, morphine (5, 7.5 or 10 mg/kg), naloxone (5 or 10 mg/kg) or naltrexone (2.5 or 5 mg/kg) on the flinch-jump test on groups of eight intact or hypophysectomized rats. The shock intensity was begun at 0.05 mA and increased in 0.05 mA increments at 30 sec intervals until a jump occurred. The shock was then decreased. The flinch threshold was noted for both the ascending and descending series. Five such trials were carried out for each rat with each drug dosage. There were no significant differences seen between the groups with any of the drugs on the flinch threshold, however, there were significant differences for the jump threshold. It took a significantly higher level of shock to elicit a jump in the hypophysectomized rats. This difference was potentiated by morphine and blocked by naloxone or naltrexone. These data indicate that hypophysectomy has induced a change in the endogenous opiate system and this change may help explain the pain relief observed in cancer patients. Supported in part by Intramural Faculty Research Grant #82-6733.

"HOW FIRM A FOUNDATION...?" SOME COMMENTS ON MISONIDAZOLE.

Donald E. Herbert, Dept. of Radiology, Univ. of South Alabama, Mobile, Alabama 36688

Some published observations on the efficacy and toxicity of Ro07-0582 have been reviewed. Our review suggests that these particular data on efficacy are "soft", perhaps even irrelevant, and that the published analyses are dubious; the location and shape of the dose-response curve for efficacy of Ro07-0582 that have been derived from these observations seem to be questionable.

The data on toxicity are more germane but because the methods of analysis that were used are inappropriate, the (published) dose-response curve is also questionable. Neither of the published analyses present confidence limits on the estimated dose-response curve for either property. (This is unfortunate because these limits are quite wide.)

The results (including confidence limits) of our analysis of these data by the standard methods of biological assay are presented. They do not affirm that consent is always well informed.

Abstracts

GLUCOSE DYNAMICS IN PYRIDOXAL- PO_4 DEFICIENT RABBITS

Shirley A. Williams, Larry R. Boots and Phillip E. Cornwell, Departments of OB/GYN and Nutrition, University of Alabama in Birmingham.

A deficiency in pyridoxal- PO_4 (PLP), the active form of vitamin B_6 , causes altered tryptophan metabolism and increased levels of xanthurenic acid (XA), a metabolite which reportedly binds to insulin. Experiments were designed to determine if a deficiency in PLP could alter glucose metabolism in rabbits and, if so, were increased levels of XA responsible. Mature female rabbits were given glucose tolerance tests (GTT), subsequently fed a vitamin B_6 -deficient diet, determined to be PLP deficient, and then given repeat GTT's. In normal rabbits, glucose levels ranged between 90 and 130 mg% prior to injecting a glucose load, surged to levels above 400 mg% within 15-20 minutes and then decreased to an average of 213 mg% within 65 minutes. The PLP-deficient rabbits had similar baseline and peak levels but decreased to only 350 mg% by 65 minutes. It was concluded that PLP-deficient rabbits had altered glucose metabolism. A series of studies were then initiated to determine whether XA might be responsible. Insulin was complexed with XA and purified by gel-filtration chromatography. Glucose levels were significantly elevated when rabbits were injected with XA alone, but equivocal results were obtained when the glucose-lowering action of XA:insulin complexes were compared to those of native insulin. Further studies of the XA:insulin complexes occurring in vivo may clarify the role of PLP in relation to glucose dynamics in the rabbit.

This work supported by DHEW Pub. Health Fellowship 5 F34 GM06777-02.

THE INDUCTION OF ILLUSORY ASSOCIATIONS IN RADIATION ONCOLOGY.

Donald E. Herbert, Dept. of Radiology, Univ. of South Alabama, Mobile, Alabama 36688

The effects of the frequency distributions of the dependent and independent variables on the concordance of a regression model as well as their effects on the size, sign, and statistical significance of its coefficients and the variance of predicted values are familiar. Apparently they are regularly ignored in analyses of non-experimental observations on dose-response phenomena and occasionally in the design and analysis of dose-response experiments in the laboratory as well as the clinic. Unless these effects are explicitly recognized in an analysis of such observations the associations between response and treatment which may be inferred from a representation of the observations by a regression equation may be largely illusory. The induction of some illusory associations between treatment and response by failure to account for these effects is disclosed in our reevaluation of a recently published experimental in vivo study. In this study some of the effects of poor experimental design were masked by the effects of an incorrect statistical analysis.

Abstracts

Myoglobin plasma levels in normal and diabetic subjects. K. S. Yackzan, F. Shamsa*, R. Thompson*, D. Carter*, and B. R. Boshell*, Diabetes Research and Training Center, University of Alabama in Birmingham.

This study summarizes the association between plasma and myoglobin levels in the presence of other covariates (age, sex, race, diabetes). The report by other workers that hemoglobin condenses with glucose forms the basis of this investigation. If such a reaction takes place between myoglobin (muscle hemoglobin) and glucose it might provide one explanation for the beneficial aspect of exercise in the athlete and the diabetic and supply the answer to why the exercising diabetic requires lesser insulin administration than otherwise needed. It is possible that myoglobin helps reduce the glucose level in the circulation and the metabolizing skeletal and cardiac muscle cells. The small number of participating athletes prevents any conclusions. This study, however, reports only the up-to-date preliminary findings from our on-going study. From a sample size of 81 subjects, (71 diabetics and 10 nondiabetics) ranging in age from 14 to 80 years, we have attempted to construct a regression model for the myoglobin as a dependent variable and all the aforementioned variables with their interaction as predictors or independent variables. In addition, we have obtained figures for two way classifications for these variables with chis-test for the association of variable pairwise. The analysis indicates that there is (1) a significant association between race and myoglobin ($p = 0.0058$; chis-test), (2) a significant correlation between age and myoglobin ($r = 0.325$ and $p = 0.003$). However, chis-test showed a borderline association ($p = .08$), (3) A significant association between sugar and age ($p = .0178$; chis-test). There was no indication of a strong correlation between sugar and myoglobin level ($r = .0089$, $p = .984$).

CHILDREN'S LUNG VOLUME MEASUREMENTS BY THE JAEGER PLETHYSMOGRAPH

K.S. Yackzan, R. Ritchey, L.A. Engstrand and B.R. Boshell. Diabetes Research and Training Center, University of Alabama in Birmingham 35294.

Using a newly designed electronic pulmonary function machine developed by the Jaeger Company, plethysmographic lung measurements (PLMs) were made for a sample of 46 children ages 5 to 12 years. This work represents the first attempt in this country to use the Jaeger plethysmograph to obtain normal values for American children. Their PLMs were then correlated with the variables height, age and weight. Such a study allows the development of PLM normals which may then be used (a) to compare the reliability of measurements on the Jaeger's plethysmograph to other machines and (b) as a diagnostic tool to determine a patient's lung volumes and hence lung function. The small sample size makes the study preliminary, but we were able to reliably establish normals for maximum vital capacity, maximum forced vital capacity, total vital capacity and three other PLMs. This work presents a description of the Jaeger plethysmograph and scatterplots of PLMs correlated with height. Further, we present data regressing PLMs on height, age and weight showing the degree to which one may rely on the latter as predictors of the former. Corresponding to results of other researchers, the height of the sample participants was the best predictor of almost all the PLMs.

Abstracts

ENZYMATIC STUDIES OF DMBA-TREATED PREGNANT RAT UTERI

Mark A. Donahue and Larry R. Boots, Dept. of Obstetrics and Gynecology, The University of Alabama in Birmingham, Birmingham, AL 35294

Rats 11-13 days pregnant were treated with 7,12-dimethylbenzanthracene (DMBA) to induce and study trophoblastic and other uterine neoplasia. Wax pellets containing 1 mg DMBA were implanted in four gestational sacs, two in each uterine horn. The rats were sacrificed at three and four months post-treatment and the uteri removed for histology and enzyme determinations. No evidence of histologic alteration was found in 48% of the specimens (subsequently designated as normal), while 43% contained squamous cell metaplasia (SCM) of the endometrium which could be a precursor of squamous cell carcinoma. The other 8% of the specimens showed evidence of uterine adenocarcinoma (AC). No trophoblastic tumors were observed. Uterine fructose aldolase activity (per mg protein) did not differ significantly between the three groups (normal 16.87 ± 2.02 , SCM 17.14 ± 2.81 , AC 19.57 ± 4.4 IU/mg protein). Uterine glucose-6-phosphate dehydrogenase activity was significantly higher ($P < 0.05$) in the SCM group than in the normal group (normal 2.00 ± 0.42 , SCM 4.10 ± 0.66 , AC 4.30 ± 1.90 IU/mg protein $\times 10^2$). Malate dehydrogenase activity was lowered in the SCM group ($P < 0.1$) and elevated in the AC group ($P < 0.05$) in relation to the normals (normal 1.68 ± 0.08 , SCM 1.34 ± 0.12 , AC 2.36 ± 0.58 IU/mg protein). These data may suggest a shift in uterine metabolic pathways after DMBA treatment and may provide more information about the mechanisms of uterine tumorigenesis.

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BEHAVIORAL EFFECTS OF TETRAHYDRO-BETA-CARBOLINES IN THE RAT

M.K. Addison, S.A. Barker* and J.M. Beaton, Neurosciences Program, Univ. of Ala. in Birmingham, Birmingham, Ala. 35294.

Current interest in the pharmacological effects of the benzodiazepine drugs (valium, librium, etc.) centers around the identification of an endogenous high affinity binding site for these agents and the isolation of an endogenous benzodiazepine-like compound. Two compounds which have been identified endogenously and suggested as possible candidates are 1,2,3,4-tetrahydro-beta-carboline (THBC) and 2-methyl-1,2,3,4-tetrahydro-beta-carboline (2-MTHBC). If either of these compounds has an anti-anxiety action, the behavioral effects should be similar to those seen with valium. Using a standard paradigm for the study of anxiolytics, the conditioned emotional response, this study reports the effects of valium (1.25, 2.5, 5.0 mg/kg), THBC (2.5, 5, 10, 15 mg/kg) and 2-MTHBC (2.5, 5.0, 10, 15 mg/kg) on a group of eight Long-Evans rats. Only valium was active in inducing anxiolytic-like behavioral disruption. The two carbolines were virtually inactive, except at the highest levels, but even then the disruption was not "valium like". The type of behavioral disruption seen was more like that found with an anxiety-inducing agent. These findings suggest that more research is needed to determine the behavioral action of the carbolines and their relationship to the endogenous benzodiazepine system. Supported in part by the Alabama Consumer Fund.

REGULATION OF FREE Ca^{2+} LEVELS BY HEART MITOCHONDRIA

Gerald L. Becker, Dept. of Biochemistry, Univ. of Ala. in Birmingham 35294

The regulation of ambient free Ca^{2+} concentration ($[\text{Ca}^{2+}]$) by Ca^{2+} translocases of heart muscle mitochondria has been studied under simulated intracellular conditions. Isolated mitochondria suspended in a cytosol-like medium including physiological concentrations of Ca^{2+} transport modulators such as Mg^{2+} , ATP and Pi regulation extramitochondrial $[\text{Ca}^{2+}]$ from either higher or lower values toward a unique and constant value within the range 0.5-0.7 μM , as determined by continuous monitoring with a Ca^{2+} -selective electrode. At mitochondrial Ca^{2+} contents less than ~ 50 ng-ion Ca^{2+} /mg mitochondrial protein, this set-point for mitochondrial Ca^{2+} buffering is shifted downward. Evidence that such lower values of the set-point may prevail in the myocardial cell was provided by experiments on isolated cardiac myocytes. After treatment of the cells with digitonin, intracellular Ca^{2+} translocases regulated $[\text{Ca}^{2+}]$ of the suspending medium toward constant values of 0.1-0.3 μM . Addition of Na^+ , which selectively increases mitochondrial Ca^{2+} efflux, led to an upward shift in the Ca^{2+} buffering set-point, indicating that mitochondria had maintained a value of (intra)mitochondrial Ca^{2+} content higher than zero, presumably through attainment of a steady state of Ca^{2+} transport. It is suggested that in vivo, heart mitochondria may buffer cytosolic $[\text{Ca}^{2+}]$ at values as low as 10^{-7}M .

AN ATTENTIONAL ANALYSIS OF SOME PAVLOVIAN PHENOMENA. John Moore, Edward J. Rickert, and Joan F. Lorden. Dept. of Psychology, University of Alabama in Birmingham, Birmingham AL 35294.

If an animal learns that stimulus A predicts the occurrence of reinforcement prior to that stimulus appearing conjointly with another stimulus (B) which predicts the same outcome, no learning is evidenced to B. Conditioning is blocked to B. In contrast, if A signals reinforcement and after conditioning A later follows a new stimulus B, conditioning is observed to B. B has become a second-order conditioned stimulus. The only procedural variation between blocking and second-order conditioning lies in the fact that reinforcement is present during the second learning phase of blocking, but absence during the second learning phase of second-order conditioning. Two contemporary learning theories which offer opposing interpretations of these phenomena were tested by comparing the performance of 6 groups of 6 rats each in standard and modified second-order and blocking preparations. The results are consistent with an attentional theory of these phenomena; animals learn to ignore stimuli which are poorly correlated with biologically significant outcomes. (Supported by NSF Grant 55-9577).

Abstracts

CAFFEINE & OTHER METHYL XANTHINES -- SURVIVAL EFFECTS ON RATS

Geraldine M. Emerson, Department of Biochemistry, Medical Center, University of Alabama in Birmingham, Birmingham, AL 35294.

Although widely consumed since early antiquity, there are even today questions concerning undesirable effects of methyl xanthines (MX). Sporadic reports of research in the literature using large doses of MX given to diverse animal species such as house flies and mice have shown decreased survival. A number of untoward effects have also been reported in the human population. Using the intermittent intake pattern of human consumption of MX; using survival based on animal studies this experiment was performed. Findings of this preliminary probe follow:

<u>Rat Group</u>	<u>No. in Group</u>	<u>Approx. Dose(mg)</u>	<u>Survival(days)*</u>
Control	21	None	439
Coffee	4	2.4 mg C	491
Decaffeinated Coffee	2	0.1 mg C	518
Tea	2	2.4 mg C	500
Chocolate	4	2.4 mg C	490
Caffeine (C) Citrate	4	2.5 mg C	522
Theobromine (TB)	4	2.8 mg TB	484
Theophylline (TP)	4	2.5 mg TP	479

*A number of rats are still alive when these data were calculated. They are treated as surviving to that date.

These preliminary data indicate that the methyl xanthine treated groups survived longer than the control group.

ENGINEERING

FEATURE MATCHING ALGORITHMS FOR MULTIPLE IMAGE REGISTRATION

H. S. Ranganath^{*} and J. S. Boland, III, Dept. of Electrical Engineering, Auburn University, Auburn, Alabama 36849

The problem of multiple image registration is that of finding n subimages in a larger image which best match the n smaller images obtained from different sensors, assuming that all smaller images are completely located within the larger image. Algorithms are considered which do not require n times the amount of computation for the multiple registration problem as for the single image registration problem. Two feature matching digital image registration algorithms, one based on moments and the other based on intraset and interset distances, which are computationally more efficient compared to the classical template matching algorithms, are presented in this paper.

PHOTOVOLTAIC POWER SYSTEMS

William G. Bradley, Dept. of Electrical Engineering, The Univ. of Ala. in Huntsville, Huntsville, AL 35899.

Photovoltaics (solar cells) are a very promising source of electric power in the near future. The primary goal of the Photovoltaic Energy Systems Division of the Department of Energy is to make electricity from photovoltaics attractive to utilities, industries and residences. Specifically, the goal is to reduce cost per peak watt to 70¢ by 1986. Even if this goal is not completely satisfied, electricity from photovoltaics should compete with other sources of electricity in a wide variety of applications. As the cost of the cells decreases, effective use of the electricity will depend upon other considerations that are only beginning to be addressed. For example, should the DC produced by the cells be converted to AC or should it be used directly. Inverters which convert DC to AC can be synchronous or non-synchronous. Non-synchronous inverters operate independently and have no connection to the power grid, while synchronous inverters are synchronized with the AC power line and add their output to the power grid. Many non-synchronous inverters have non-sinusoidal outputs and/or have poor conversion efficiency. Synchronous inverters often add current with high harmonic content and/or poor power factor to the power line. Storage must be added to the photovoltaic system unless energy is needed only when the sun is shining or the power grid is used to supply energy when the sun is not shining. Much planning and design will be required if these new systems are to be used effectively.

APPROACHES TO MULTIPLE TARGET HANDOFF PROBLEM

D. V. Satish Chandra* and J. S. Boland, III, Dept. of Electrical Engineering, Auburn University, Auburn, Alabama 36849

Multiple target handoff is that of designation and handing off of multiple targets from a precision pointing and tracking system to several helicopter-borne missile seekers almost simultaneously. The most important problem of automatic target handoff is that of matching the fields of view (FOV) of seekers with the corresponding regions in the precision pointing and tracking system FOV. Template matching methods such as correlation and sequential similarity detection algorithms are widely used for the determination of local similarity between images. Several techniques such as two-stage template matching, course-fine template matching, hierarchical search and binary correlation are reviewed. Finally, an image matching technique using structured features is presented with simulation results. Feature matching techniques are very attractive for multiple image registration since matching can be accomplished with less computation and less memory storage requirements as compared to that required by classical methods.

Abstracts

CONTROL PRESSURE OF A CHEMICAL REACTOR SYSTEM USING GASPIV SIMULATION

Rishi Raj Chowdhury, Systems Analyst, Stockham Valves & Fittings, Birmingham, AL

The objective of chemical reactor simulation is to model and analyze the system involving continuous process subject to controls required by surge tank pressure (STP). Chemical reactor system considered in this paper consists of four reactors in parallel and a compressor with a constant molal flow rate. Initial surge tank pressure was set. Simulation studies involving control of surge tank pressure was done in two areas. First, at a low constant critical pressure, average surge tank pressure rises with rise in nominal pressure. If the constant critical pressure is increased, the surge tank pressure remains constant with rise in nominal pressure. Second, at a constant nominal pressure, average surge tank pressure rises very rapidly with rise in critical pressure. These two studies provide a guideline to control pressure in a chemical reactor system.

For the simulation of the system, GASPIV simulation language was used in a combined continuous cum discrete environment. GASPIV provides a concept of modeling a system in time and the state-space dimension. In GASPIV, status of a system can be described in terms of a set of entities, their associated attributes and state variables.

COMPUTER REPRESENTATIONS OF ENVIRONMENTAL CLUTTER

T. A. Johnson, E. R. Graf
Departmental of Electrical Engr.
Auburn University, Alabama 36849

W. C. Holt
U. S. Army Missile Command
Redstone Arsenal, Alabama 35898

Abstract

The digital computer's role in the modelling of environmental clutter is becoming increasingly important. It thus becomes vital that a sound method is implemented to model the radar's environment. This paper presents a scheme which models both ground and atmospheric clutter through the use of "clutter-cubes". Methods to change resolution and to represent and store radar cross sections are explained.

DESIGNING A SYSTEM USING DATA FLOW DIAGRAMS

Rishi Raj Chowdhury, Systems Analyst, Stockham Valves & Fittings, Birmingham, AL

Data flow diagram (DFD) is considered to be one of the most valuable systems analysis and design tool. It can illustrate not only the present manual or computerized system by flow of data but also clearly identify the complicated processes. Data flow diagram is a technique to illustrate a system by expanding each of the processes which are at most general level to its most detailed level.

A system described by most expanded data flow diagrams clearly illustrates each of the processes, data stores, flow of data, source or destination of data and reports or documents printed.

In this paper, examples are chosen from a Human Resource System (example of business systems, in general) and a Population Genetics System (example of scientific systems, in general). A DFD is drawn at a most general level and then the processes are expanded so that each of the processes could be clearly illustrated and programmed. In case of more than one possible expansion of a DFD, one with less complexity and more efficient is chosen.

ENERGY CONSERVATION IN ENERGY-INTENSIVE UNIT
OPERATIONS: DISTILLATION, EVAPORATION, AND DRYING

Bharat Shah and Beverly Tanner, Chem. Eng. Dept., Auburn Univ., Ala.

Improved usage of energy in energy-intensive unit operations of distillation, evaporation, and drying is studied in this work. Energy usage can be improved by a careful thermodynamic analysis of the separation operations for existence of irreversibilities due to transport processes, mixing, and throttling. Computer simulations are carried out to obtain quantitative answers for energy saving that can be effected by having appropriate conditions. The control actions required to bring about such conditions are also examined. It is shown that substantial energy-savings can be effected by employing the recommended conditions and control actions.

Abstracts

THEORY OF DISTURBANCE-UTILIZING CONTROL; SOME RECENT DEVELOPMENTS

W. C. Kelly, Guidance and Control Directorate,
US Army Missile Command, Redstone Arsenal, AL 35898
C. D. Johnson, Department of Electrical Engineering,
The University of Alabama in Huntsville, Huntsville, AL 35899

This paper reviews the basic theory of disturbance-utilizing control for linear plants with quadratic performance criteria and then presents some recent extensions of that theory. The theory of disturbance-accommodating control deals with the design of feedback controllers which can maintain set-point regulation or servo-tracking in the face of uncertain external disturbances. There are essentially three modes in which such controllers can operate: the disturbance-absorbing (- cancelling) mode, the disturbance-minimizing mode and the disturbance-utilizing mode. In the disturbance-utilizing mode, the controller makes maximum (optimal) utilization of the external disturbances to assist in accomplishing the primary control task (set-point regulation, servo-tracking, etc.). In this paper the basic theory of the disturbance-utilizing mode of control is summarized for the case of linear plants with quadratic performance criteria and the extension of that theory to the steady-state controller problem is presented. Two examples are used to illustrate the new results.

THE METAL MINES OF CORNWALL

Thomas A. Simpson, Department of Mineral Engineering, The University of Alabama, University, AL 35486.

The mines of Cornwall, England have been producing tin since the days of the Phoenicians. Descendants of the Cornishmen, Devonshiremen, and Welshmen emigrated to the United States in the eighteenth and nineteenth centuries and their customs, terms, expressions, and methods have left an impact on the American mining scene.

A brief history and generalized geological discussion of the mines of Cornwall and Devonshire are presented as a result of a recent visit to the only producing tin mine in the area.

The paper is of interest to mining and other engineers in the Alabama mineral industry because the origin of many American mining terms and the methods of mining can be traced to these rugged and individualistic English miners of yesteryear.

Abstracts

ANTHROPOLOGY

HIGH SCHOOL INVOLVEMENT IN ALABAMA ARCHAEOLOGY

John C. Hall. Alabama Museum of Natural History, and Carey B. Oakley. Office of Archaeological Research, Univ. of Alabama, University, AL 35486.

Benefits are to be gained through the direct involvement of the archaeological profession with the general public, especially at the high school level. In addition to the promotion of an archaeological ethic, appreciation of the state's archaeological heritage and knowledge of the discipline, students and teachers can be of real value in selected aspects of the information gathering process. The Alabama Museum has recently completed two years experience in the use of high school students as archaeological fieldworkers in support of investigations conducted for the Alabama Historical Commission by C. B. Curren Jr. This program has been extremely successful in both quality of work and benefit to the students. The Office of Archaeological Research has initiated an additional program which is now at the initial field testing stage. High school classes, under the supervision of their teachers (trained and supported by the O.A.R. and the A.M.N.H.), engage in actual archaeological survey, with the product being the preparation of Site Survey Report forms of a quality suitable for inclusion in the O.A.R.'s electronic data processing files. Benefits of this program include: supervised and controlled participation in an actual archaeological experience for the students, heightened awareness of the students, schools and families of archaeological process, and acquisition of badly needed archaeological site data.

DYNAMICS OF MALE IMMIGRATION IN MACACA MULATTA

Bruce P. Wheatley. Dept. of Anthropology, Univ. of Ala. in Birmingham, Birmingham, AL 35294.

Research on inter-male troop transfer in free-ranging rhesus monkeys was conducted on Morgan Island, South Carolina. The 400-acre Island consists of over 1000 identified animals in a dozen different troops. Previous approaches to understand male immigration have failed to account for their diverse forms. This has led to considerable controversy over the evolution of the form and adaptive basis of such things as replacement, tenure, and infanticide. To solve this controversy research design followed a cost/benefit analysis for each focal male. This approach recognizes the many options available to a male and a female which might be expected to affect their reproductive success. The results show that these options can vary according to such conditions as an individual's age, rank, tenure, ontogenetic experience, and kin. Research supported by a Graduate School Faculty Research Grant at U.A.B. I am especially grateful for the cooperation of Dr. Taub, Associate Director of the Yemassee Primate Center.

Abstracts

BEHAVIOR, PSYCHOLOGY, AND SEX IN AN ANTHROPOLOGICAL SETTING

Avery G. Church. Dept. of Sociology and Anthropology, Univ. of So. Ala., Mobile, AL 36688

The research was concerned with differences between female and male anthropology students at the University of South Alabama in extent of extracurricular activities and in level of academic classification. The relations of these variables to academic achievement, level of occupational plans, delay of gratification, feelings of personal control, and concepts of present self, ideal self, and self in five years were examined for each group. The measures were based on questionnaire items administered in December of 1979 to 19 females and 24 males, representing about 98% of the students in two regular day classes in introductory anthropology (a late morning and an early afternoon class). The null hypothesis was adopted regarding group differences, and extent of extracurricular activities and level of academic classification were expected to be positively related to the other variables within each group. No differences were significant at the .05 level. The above hypothesized relations received mixed support from the analyses of the data and yielded contrasting patterns for the males versus the females. For the females 16 of the 22 correlations were as anticipated, but none were significant at the .05 level. For the males 16 of the 22 correlations were not as expected, and the negative correlation between level of academic classification and successful-unsuccessful for the self in five years was significant at the .05 level. The sizes and diversification of the samples concerning the two focal variables were discussed as probable factors influencing the scarcity of significant findings.

THE ORIGINS OF PASTORALISM IN THE CHILEAN ANDES

Brian Hesse. Dept. of Anthropology, University of Alabama in Birmingham, Birmingham, AL 35294.

An independent center of animal domestication was located in the mountainous regions of western South America. Here a unique barnyard technology developed that included llamas, alpacas, guinea pigs, and Muscovy ducks. The search for the origins of the husbandry of these animals has concentrated largely in the Ecuadorian and Peruvian parts of the Andes Mountains. This report extends our knowledge of the process to the hyper-arid regions of inland northern Chile, based on a series of 3-2000 BC (Archaic) sites located along the eastern border of the Salar de Atacama. The animal bone samples from the collections recovered by Lautaro Núñez A. of the Universidad del Norte in Antofagasta from Puripica, Tambillo, and Tulan are described. An osteometric approach to separating the morphologically similar camelid forms is illustrated. Finally, descriptive, statistical techniques are used to develop a picture of how each of the forms was utilized by the inhabitants of the three sites and suggest a pattern to the technological change. This research was supported by a U.A.B. Faculty Research Grant and the Smithsonian Institution Latin America Fund.

Abstracts

BOTANIC IMPLICATIONS FOR SEASONAL OCCUPATION AT SITE 1Ta171

Eddie M. Hatcher. Univ. of Ala. in Birmingham, Birmingham, AL 35294.

Site 1Ta171 located just South of Talladega, Alabama in Talladega County was excavated in the Summer of 1979. The site is situated on the floodplain in a meander loop of Talladega Creek. Diagnostic ceramic types indicate a Late Mississippian to Proto-Historic occupation of this site. Analysis of soil samples for plant remains yielded 2,812 carbonized specimens representing twenty taxonomic groups identified to at least the family taxon. Implications for seasonal occupation of Site 1Ta171 as reflected by the carbonized plant remains recovered from this site will be discussed.

COMPUTER ANALYSIS - LITHIC SCATTERS AT BEAVERDAM CREEK, AL.

Caryn Hollingsworth. Univ. of Ala. in Birmingham, Birmingham, AL 35294

Computer analysis was undertaken to determine if well-documented amateur collections could yield valuable cultural and historical information concerning the early indigenous inhabitants of the area. Analysis was made on the attributes of form, material type, size and use characteristics of the lithic artifacts and the environmental variables of soil type, distance from water and site location along Beaverdam Creek. Basic statistical computation used was chi square, with indicated manipulation of data to achieve maximum results.

WOODS RUINS: AN EXERCISE IN ARCHAEOLOGICAL METHOD

Marilyn Vance. Univ. of Ala. in Birmingham, Birmingham, AL 35294.

At the request of the Ruffner Mountain Nature Center, a ruin on this property was investigated by the U.A.B. Historical Archaeology Program in order to develop the site as a trail exhibit. Ethnohistorical information was contradictory suggesting three possible hypotheses for the nature of the site (called Wood's Ruins, 1JE123). Excavation during the summer of 1980 was employed to test these tentative histories. Results indicated that only one potential explanation could account for the materials recovered. This report details the archaeological argument that led to this conclusion.

Abstracts

PATRIARCHAL NARRATIVES: HISTORY OR MYTH

Diane A. Ballinger. Univ. of Ala. in Birmingham, Birmingham, AL 35294.

Some of the problems of using the patriarchal narratives of the Old Testament as tools for research for Bronze Age sites are examined. The nature of oral tradition and its validity and value as a tool for ethnographic research are scrutinized and the conclusion is reached that although the potential for archaeology proving the Old Testament to be true is great, at this time not enough is known. Thus, the patriarchal narratives should be considered as myths and used as ethnographies.

THE CULTURE-SYNTAX INTERFACE

Jill Brody, Dept. of Anthropology, Univ. of Ala. in Birmingham, Birmingham, AL 35294.

The interaction of cultural presuppositions with grammatical mechanisms is highly evident when language is examined in use in cultural contexts. This paper investigates a particular case of this interaction in Tojolabal Mayan (a modern-day Mayan language spoken in Chiapas, Mexico): the use of possession and inclusive pronouns. It is demonstrated that the proper use of these grammatical mechanisms involves cultural presuppositions and that these factors are brought into judgements about grammaticality of constructions using these mechanisms.

MESOPOTAMIAN ZOOLOGY: FOLK KNOWLEDGE OR SCIENCE?

Paula Wapnish. Dept. of Anthropology, Smithsonian Institution, Washington, D.C. 20560.

Cuneiform texts from Mesopotamia reveal a rich knowledge of animals based on empirical data. In the past, scholars claimed that these ancient observations fell short of being true "zoology" in the western scientific idiom. This report examines the interface between western zoology and Mesopotamian ethnobiology. Only from this perspective can ancient folk knowledge be apprehended in its broadest applications and the integration of animals in Mesopotamian society fully explored.

Abstracts

MODERN AND PREHISTORIC MAYA POTTERY MANUFACTURE

Douglas Donne Bryant. B.Y.U., New World Archaeological Foundation, San Cristobal de las Casas, Chiapas, Mexico.

Primitive pottery manufacturing techniques practiced by modern Maya in the Chiapas Central Plateau have been little affected by the introduction of 20th century technology. Almost every aspect of the potter's craft is traditional and is carried out with tools and techniques which were readily available to their prehistoric Maya forebearers. Ethnoarchaeological analysis of the modern pottery manufacturing techniques has resulted in the identification of an activity set composed of durable tools and materials used in the manufacture of pottery. A quick survey of artifacts from prehistoric Maya sites identified these same tools and materials, which indicates that pottery was manufactured at the sites. The identification of the pottery manufacturing activity set is a first step toward the identification of prehistoric centers of pottery manufacture. As these centers are recognized, they will provide archaeologists with strong empirical data for studies of pottery trade and exchange.

ARTHRITIS: AN ETHNOSCIENTIFIC APPROACH

Morris Simon, Dept. of Sociology, Troy St. Univ., Dothan, AL 36301

In cognitive anthropology, ethnoscientific analyses have been primarily descriptive. The comparative technique of ethnoscience utilizes the non-cultural ("etic") dimension of a focal phenomenon as a baseline for comparative, culture-bound ("emic") descriptive statements. In this paper, the focal phenomenon (rheumatoid arthritis) has no known culture-free (etic) etiology, while various cultural (emic) knowledge systems specify such an etiology. Prevalent emic prescriptive dietary therapies such as Vermont folk medicine relate rheumatoid arthritis to acid -- alkaline imbalances, a correlation which is compared to current "etic" research on the relationship between diet and rheumatoid arthritis. The theoretical implications suggest an heuristic value of ethnoscientific approaches as hypotheses-generating studies supporting the etic or "culture-free" understanding of universal empirical phenomenon.

MINUTES

ALABAMA ACADEMY OF SCIENCE
ANNUAL BUSINESS MEETING
Auburn University
Auburn, Alabama
April 3, 1981

- 1) President Geraldine Emerson called the meeting to order. After a brief welcoming statement, she called for the report of the Counselor to the Alabama Junior Academy of Science.
- 2) Dr. James Welker, Counselor to the AJAS, summarized the AJAS program events which had or would occur. Since the AJAS program would not be completed until the following day, Dr. Welker noted that his final report would be forwarded to the Secretary for inclusion in the minutes.

(Secretary's note: On April 17, 1981, the Secretary received the following report from Dr. Welker).

Eighty-three schools paid membership dues for the 1980-81 school year. This includes the following new schools:

Pine Hill High School, Pine Hill, AL
Dothan High School, Dothan, AL
Pelham High School, Pelham, AL

Three hundred and four students and teachers registered with AJAS for the Annual Meeting. Members of the Southeast Region who hosted the meeting commuted daily and, therefore, are not included among those registered at the motel; however, more than 350 teachers and students attended the Friday night banquet.

Beautiful weather, superb housing and meeting facilities, and a well-planned program for both students and teachers all contributed to one of the most successful Annual Meetings in recent years. Mrs. Faye Lawrence, AJAS Local Counselor, is to be commended for her efficiency in attending to all the needs of the Junior Academy.

Although considered by the AJAS Executive Committee as a one-time experiment, the inclusion of the Paper Competition in this year's meeting has resulted in such favorable response from both students and teachers that it is strongly recommended to be included in the Annual Meeting of 1982.

The following students were judged to be first-place winners in their respective categories of the JSJS paper competition, and as such will receive an expense-paid trip to attend the National Symposium of JSJS to be held at West Point Academy, April 29-May 3, 1981.

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Biological Sciences:

William Chitwood, Lawrence County High School, Moulton, Alabama
"The Role of Gibberellins in Phytochrome-Mediated Lettuce Seed Germination"

Engineering

Blake Brown, Jacksonville High School, Jacksonville, Alabama
"Computer Controlled Multifunction Pigeon Behavioral Analysis: Hardware and Software"

Humanities:

Maria Vitelli, Coffee High School, Florence, Alabama
"Broiler Litter as a Feed Source for Ruminants"

Mathematics:

Jerry Pease, Randolph School, Huntsville, Alabama
"Complex Roots of a Cubic Equation"

Physical Sciences:

Andrea Ray, Coffee High School, Florence, Alabama
"Correlations Between Gravitational Forces and Volcanic Eruptions"

Blake Brown was selected to read his paper at the National Symposium.
Mr. Eugene Omasta and Mrs. Faye Wells will accompany the five students.

Student Officers elected at the AJAS Business Meeting held Saturday morning were:

President: John Alexander, Austin High School, Decatur

Vice President: Brad Brown, Athens High School, Athens

Secretary: Kimberly Staples, Parker High School, Birmingham

Treasurer: Cassandra Minard, Parker High School, Birmingham

This year's recipients of the annual awards were:

\$500.00 Scholarship ----- Lori Phillips, Mary Montgomery High School,
Semmes

Alternate - Rori Sutton, Escambia County High School, Atmore

AAAS Award --

Kim Bandy, Escambia County High School, Atmore
Greg Mount, Childersburg High School, Childersburg

Minutes

Student Research

The following students were awarded grants to participate in the annual summer archaeological program of the Alabama Museum of Natural History:

Thomas Denny, Jr., Ozark High School
Tracy Mayfield, Childersburg High School
Stephanie Staff, Escambia County High School
Kim Bandy, Escambia County High School
Brown Hawkins, Bradshaw High School, Florence

Outstanding Science Teachers

Less than 5 years teaching experience:
Miss Cynthia Tillery, Bradshaw High School
More than 5 years teaching experience:
Mrs. Joyce Brewer, Childersburg High School

Outstanding Region of AJAS: Mobile Region, Counselors: Betty Bigham and Jane Nall

- 3) President Emerson then asked for the report of the State Coordinator of Science Fairs. Mrs. Elsie Spencer presented the following:

Six regional fairs were conducted. Five of these fairs were affiliated with Science Service and will send finalists to the International Science and Engineering Fair, Milwaukee, Wisconsin, May 11-16, 1981.

These Fairs, their directors, sponsoring institution, the finalists and their schools are:

Mobile Regional: Robert Rasheed, University of South Alabama; Doug Dumas, Grove Hill Academy and Cathy Irby, Choctaw County High School.

Southeast Regional: Billy Norman, Troy State University; Norman Powell, Opp High School and Belinda Taylor, Opp High School.

Northeastern Regional: Clyde McSpadden, Jacksonville State University; William Blake Brown, Jacksonville High School and Stephen Alan Jennings, Childersburg High School.

East Alabama: W.L. Shands, Auburn University; Rose G. Lawson, St. James School, Montgomery, and Allen Broyles, Jefferson Davis High School, Montgomery.

Central Alabama: Robert Stiles, Samford University; Donna Elaine Fisher, A.H. Parker High School, Birmingham and Jason Errol Johnson, Resource Learning Center, Birmingham.

Minutes

West Alabama: University of Alabama Tuscaloosa, will not send finalists to ISEF. Southeast Regional will send only one finalist. Travel and housing will be arranged by the state coordinator.

Mrs. Spencer then summarized the report of the ad hoc committee for study of Alabama Science Fairs.

- 4) President Emerson then asked for the report of the Gorgas Foundation. Dr. L.S. Hazlegrove presented the following:

The Gorgas Scholarship Foundation announced today the rankings of the finalists in the 1981 Alabama Science Talent Search.

The winner of the cash award of \$1,600 tuition grant was Barbara Diane Allan, 7803 Michael Circle, Huntsville, Alabama, 35802, from Grissom High School; Teacher: Mrs. Roberta A. Hill.

Alternates are:

- 1st William Blake Brown, P.O. Box 51, Jacksonville, Alabama, 36265, from Jacksonville High School; Teacher: Lee Messer.
- 2nd William Shelton Chitwood, P.O. Box 37, Moulton, Alabama, 35650, from Lawrence County High School; Teacher: Nancy C. Coffey.
- 3rd Andrea Jean Ray, 305 N. Locust Street, Florence, Alabama 35630, from Coffee High School; Teacher: Linda J. Kanipe.
- 4th Alan Edward Madewell, 135 Creekwood Circle, Florence, Alabama, 35630, from Coffee High School; Teacher: Linda J. Kanipe.
- 5th John Menza Dudley, 4400 16th Avenue, Phenix City, Alabama, 36867, from Glenwood School; Teacher: Margaret B. Mosley.
- 6th Stanley Ray Beard, 301 Golf View Drive, Jackson, Alabama, 36545, from Jackson Academy; Teacher: Roy Henson Schell.
- 7th Thomas Ivon Moore, Rt. 4, Box 74B-3, Elba, Alabama, 36323, from Elba High School; Teacher: Frances B. Prior.
- 8th Sonya Renee Parrish, 518 Hermitage Drive, Florence, Alabama 35630, from Bradshaw High School; Teacher: Mary Nell Gonce.

The rankings were established by a panel of judges consisting of department heads, deans, and professors from many of the leading Universities and Industries in Alabama.

Dr. Leven S. Hazlegrove, Professor and Chairman, Department of Chemistry, Samford University, is Chairman of the Judges Committee.

Minutes

Winners and alternates in the Gorgas Contests receive offers of tuition scholarships to colleges and universities in Alabama for the study of science. The Gorgas Foundation is named for General William Crawford Gorgas, the Alabama physician who conquered yellow fever in the Panama Canal Zone while serving as Surgeon General in the U.S. Army. The purposes of the Foundation are to promote interest in science and to aid in the education of promising students.

- 5) President Emerson then asked Dr. John Pritchett for the report of the Secretary. Dr. Pritchett offered the following:

A. Membership

Total Membership (March 17, 1980)	688
New Members (March 18, 1980-April 1, 1981)	191
Members Deceased	2
Members Resigned	5
Members Dropped (Non-Payment of Dues)	108
Total Membership (April 1, 1981)	764
Net Change from March 17, 1980	+76 (+11%)

He further reported that 22 new membership applications had been received during the course of the meeting and that total meeting registration for the senior academy was 215.

Dr. Pritchett then summarized the following information on membership by section of the Academy

Section	Mar. 17, 1980	Apr. 1, 1981	Net Change
I. Biological Sciences	160	193	+33
II. Chemistry	49	61	+22
III. Geology	31	28	- 3
IV. Forestry, Geography and Conservation	12	15	+ 3
V. Physics and Mathematics	48	56	+ 8
VI. Industry & Economics	39	38	- 1
VII. Science Education	33	38	+ 5
VIII. Social Sciences	34	41	+ 7
IX. Health Sciences	101	112	+11
X. Engineering	38	46	+ 8
XI. Anthropology	11	21	+10
88	94	85	- 9
99	38	30	- 8
TOTAL	688	764	+76

Minutes

- 6) President Emerson then asked for the report of the Place of Meeting Committee. Dr. William Alford presented the following:

As previously arranged, the 1982 meeting of the Academy is scheduled at the University of Alabama in Birmingham.

On February 2, 1981 Dr. Roger Sayers, Acting Academic Vice President at the University of Alabama in Tuscaloosa, issued an invitation to the Academy to hold its 1983 annual meeting on the University campus. Our committee recommends acceptance of Dr. Sayer's invitation and appropriate notification to the University of our acceptance and appreciation.

Dr. Sam Barker moved that Dr. Sayer's invitation be accepted and that Dr. Kenneth Ottis notify the University of the Academy's acceptance and express the Academy's appreciation. The motion was seconded and passed.

- 7) President Emerson then asked for the report of the Resolutions Committee. Dr. Hoyt Kaylor presented the following:

WHEREAS the Alabama Academy of Science has held its fifty-eighth annual meeting this April 1981 at Auburn University and has enjoyed the hospitality of the University, now therefore

BE IT RESOLVED that the Academy express its gratitude to Dr. Hanly Funderburk, President of the University, and to the University for hosting this meeting. To Dr. Curt Peterson, Chairman of our local hosts, and to the members of his Host Committee, Mrs. Nancy Kuykendall, Dr. Robert Gudauskas, Dr. Ken Ottis, Mrs. Faye Lawrence, Dr. John Freeman, Dr. James Bradley, Dr. William Current, and Dr. Walter Kelly; to the Faculty and Staff of the University; and to all the many others who contributed to the success of this meeting, we, the members of the Academy, express our appreciation for their efforts on our behalf.

BE IT FURTHER RESOLVED that the Academy express its appreciation to Dr. Alford F. McFee for his presentation to the join Academies.

BE IT FURTHER RESOLVED that the Academy express its appreciation to those who retire from leadership in the Academy this year, especially to Dr. Geraldine M. Emerson, President, Dr. Bill Helms, Treasurer, and to Dr. James Welker, Counselor to the Alabama Junior Academy of Science, who is retiring after 10 years in this office.

WHEREAS the Academy has received notice of the death of Dr. Alan Hisey, retired Professor of Biochemistry at the University of Alabama, Birmingham, and

WHEREAS Dr. Hisey was a long-time members of the Chemistry Section of the Academy,

Minutes

BE IT RESOLVED that the Academy extends its sympathy to the family of Dr. Hisey.

WHEREAS death has deprived the Academy of the membership of Mrs. Jan Eagles of the Biological Sciences Section of the Academy

BE IT RESOLVED that the Academy extend its sympathy to the family of Mrs. Eagles.

BE IT FURTHER RESOLVED that appropriate letters together with copies of this resolution be sent by the Secretary to the families of both Dr. Hisey and Mrs. Eagles.

It is hereby moved by the Committee on Resolutions that the above be accepted and entered in the Minutes of the Academy.

The motion was seconded by Dr. Kenneth Ottis and was passed.

- 8) President Emerson then asked for the report of the Research Committee. Dr. Al Belmonte indicated that, since several papers under consideration for awards had not been given, his final report would be delivered to the Secretary at a later date for incorporation into the Minutes.

(Secretary's note: The following final report was received from Dr. Belmonte)

The Research Committee is responsible for administering three programs consistent with the Bylaws of the Academy: Student Travel Awards, Student Research Grants, and Student Research Awards.

The Research Committee received nine Travel Award requests to support student travel to the annual meeting. These requests totaled \$525. The committee has awarded \$350 of the budgeted \$600 for this activity. A list of students and amounts were forwarded to the treasurer and the awards were available as the students registered for this meeting. These checks are available at the registration table if you have not picked up your awards.

The Research Committee has nine Student Research Grant requests, of which four will be funded at a maximum of \$250 each. The following grants are approved:

- (1) Karl P. Beiersdorfer - Energetic Electron Emission By A Vacuum Spark Plasma - Dr. Eugene Clothiaux, Auburn University, Advisor - \$241.
- (2) Michael W. Fountain - Development of Liposome Carrier Vehicle for Gentamicin - Dr. Ronald Schultz, Auburn University, Advisor, \$250.
- (3) Suzanne A. Whitlock - Ultrastructural Parameters of Pathogenesis of E. Roperi in the Cotton Rat - Dr. William Current, Auburn University, Advisor - \$250.

Minutes

- (4) Linda J. Mason - Scent Marking Behavior of the Grey Squirrel - Dr. Robert Lishak, Auburn University, Advisor - \$250.

The Research Committee had four final papers entered in the Student Research Awards Competition: Two in Biological Sciences, one in Forestry, Geography & Conservation and one in Physics & Mathematics. This award includes a prize of \$50 and a certificate.

Winners are:

- (1) In Biological Sciences - Dorothy B. Geiger - A Study of Yeasts Isolated From Animals - Auburn University, Dr. Marie Attleberger, Advisor.
- (2) In Physics and Mathematics - Adila Dodhy - Rate Constants for the Formation of ArF & Ar - Auburn University, Dr. John Williams, Advisor.
- (3) In Forestry, Geography & Conservation - Mary Padgett - Methodology for Development of Modular Stimulation Models - Auburn University, Dr. G.S. Hines, Advisor.

The committee wishes to thank all those who competed for the awards and grants.

- 9) President Emerson then asked for the report of the Senior Academy Auditing Committee. Wilbur DeVall summarized the following report.

The Audit Committee, consisting of Sharon Hamilton and Wilbur DeVall as chairman, met with Academy treasurer Billy P. Helms in Tuscaloosa, Alabama on Friday, March 6, 1981 for the purpose of making the 1981 audit of the treasurer's records. The Committee was given copies of:

1. Treasurer's Report Income Statement - Dec. 31, 1979 to Dec. 31, 1980
2. Changes in Financial Position - Dec. 31, 1979 to Dec. 31, 1980.
3. Revenue and Expenditure Report for 1978, 1979, and 1980.

In addition to the preceding documents, the Committee looked over a ledger book showing income and expenditures for a series of years, bank statements and canceled checks, and a statement of earnings on a Certificate of Deposit listed as a Money Market Certificate.

With reference to Item No. 2 shown above, the Committee made the following observations for the record.

Minutes

1. Total holdings as of Dec. 31, 1979 listed as \$24,721.64 should have been \$24,721.04.
2. Total holdings as of Oct. 11, 1980 should have been as of Dec. 31, 1980.
3. The checking account is in the First National Bank of Tuskaloosa; a spelling the Committee was not familiar with.

With reference to Item No. 3 shown above, the Committee has some difficulty identifying completely expenditure items from the terminology used in the statement. For example, expenditures for "Outstanding Student" and "Outstanding Teacher" were not identified with the AAS or AJAS and had to be further researched.

The Committee found no reason to question the figures in the reports and statements submitted. The true meaning of some of the expenditures had to be further researched following the day of the audit. Suggestions of the Committee, including observations and information obtained from officers and committees following the audit are being set forth below. The Committee recommends that the treasurer be commended for his stewardship of funds under circumstances where communications were not complete or provided.

Suggestions and Observations

1. Bank statements and the check book should be reconciled monthly rather than twice during the year.
2. The budget for the Academy should be more detailed so that income and expenditures are self-explanatory. For example, a budget for the Research Committee shown as \$2,150 should be shown as:
Research Committee \$2,150.
Student travel grants \$ 600.
Student research grants . . . 1,000.
Student research awards . . . 550.
3. A new system of ledger-book accounting should be considered to facilitate finding pages related to specific income or expenditure items.
4. Accounting for dues paid by individuals, institution, and other agencies appears to need simplification so that one book or listing suffices for all.
5. Transfer of the Certificate of Deposit each three years, or from one treasurer to the next, appears unnecessary but may be desirable.
6. Overlap of duties of the old and new treasurers every three years is necessary, primarily to handle bookkeeping associated with the annual meeting.
7. Under the new system whereby the secretary receives all dues, payments and accounts for such submissions and then turns the payments over to the treasurer may suggest that both officers be bonded.
8. The amount of the bond covering the treasurer is now for \$5,000 while he is responsible for funds in excess of \$25,000. The present premium of \$30 per year, payable in June would increase but this coverage should be investigated.

Minutes

9. Current interest on the Certificate of Deposit runs about \$2,400 and accrues to the amount invested rather than becoming available for expenditure for current expenses. This amount for 1980 (\$2,414.99) would about cover the expenses of the president, secretary, and treasurer which were \$1,063.32, for a two-year period.
10. The budgeting process should consider encouraging each elected officer and each appointed committee chairman to do his job without having to spend his own funds. This could be accomplished by listing each of these persons in the budget with an amount of money obligated to each.
11. Bills submitted by an officer, committee chairman, or other authorized person should be endorsed "Approved for payment" before they are sent to the treasurer for payment. During 1980 this procedure would have eliminated payment of one bill for \$488.71 which, upon investigation, will now have to be reimbursed to the treasurer from a fund which should have initially paid it in full.
12. While the treasurer estimated expenditures against income for the year 1978, totals for three consecutive years show percentage changes between years as follows:

	<u>1978</u>	<u>1979</u>	<u>1980</u>
Income	+29%+19%	
Expenditures	+29%+26%	

13. Only income that passes through the books of the treasurer should be shown when destined for the AAS. Likewise, only expenditures from AAS funds should be shown. Similar figures for the Junior Academy that are not AAS funds should not appear.
14. Income designated for a specific purpose should be so noted in budgets and financial statements, such as, Auburn University Support (for the Journal).
15. When financial support is received by the AAS for expenditure by the Junior Academy and run through the books of the treasurer, the amounts appear the same. Entries should identify intent of the income and expenditure.
16. Financial support by Auburn University, which in the past has been \$3,000 per year, will according to a reliable source, be withdrawn for 1981-82.
17. It would be helpful if non-recurring expenditures were designated in financial statements in some appropriate manner.
18. A system should be developed whereby all expenditures could be charged against a budgeted category. This would indicate where over- and under-expenditure during the year could be anticipated.
19. Only new expenditures, approved by the Executive Committee and so recorded in the minutes, should be paid by the treasurer.
20. Errors, which appear to be typographical, should be edited before financial statements are distributed. For example, the Audit Committee had to research a \$1,310 item shown as income and corresponding expenditure in the Treasurer's Report of Income as "A.A.A.S. Support to Jr. Academy of Science" and in the Revenue and Expenditure Report for the same year as "AAS Support to Jr. Academy" in the same amount, \$1,310.
21. Next year, appoint a more experienced and intelligent Audit Committee!!!

Minutes

The following information was received from Dr. Welker, March 20, 1981.

In the treasurer's report income statement, the following line items are explained as follows under income and expenditure.

Jr. Science Symposium - this money \$1,425 was the income from donations received by the chairman of the Board of Trustees, Dr. Barker, from industries for the Junior Science and Humanities Symposium.

Jr. Academy of Science - this line item should be identified with the U.S. Army, \$7,800 which is used for the Junior Science and Humanities Symposium and is received from the National Office of this agency.

A.A.A.S. Support to Jr. Academy of Science - this line item represents an amount received as a one-time grant from AAAS for a Science Teachers Conference. It is a one-time amount unless application is made again and the grant is funded.

In the treasurer's Revenue and Expenditure Report for 1978, 1979 and 1980, the following should be noted.

Neither the AJAS nor the AAS makes an award to an outstanding student!

The AAS has consistently made an annual award of \$100 for an Outstanding Teacher award. This should be a continuing item. However, in the accounting statement referred to the \$100 amount does not show as an expenditure in 1978 and 1980. Dr. Welker says that the two amounts of \$200 and \$100 shown in 1979 opposite Outstanding Student and Teacher should have been one item, namely, Outstanding Teacher. The omission of the \$100 payment for the two years was lumped in 1979 as \$300 but incorrectly shown as supporting two different awards.

10) President Emerson then asked for the report of the Nominating Committee. Dr. Wilkes indicated that his report was incomplete since some of the sections had not reported their nominees for Chairman or Vice-Chairman. Dr. Wilkes placed the following in nomination for 1981-82.

President: Kenneth Ottis, Auburn University
1st Vice President: Charles Baugh, University of South Alabama
2nd Vice President: Raymond Isbell, University of North Alabama
Treasurer: James Bradley, Auburn University
Board of Trustees: Samuel Barker, University of Alabama,
Birmingham
Walter Baker, Alabama Power Company
Reuben Boozer, Jacksonville State University
Joseph Thomas, University of North Alabama
Counselor to AJAS: Eugene O'Masta, Troy State University

President Emerson then called for further nominations from the floor. There being none, a motion was made and seconded that the nominations be closed. The motion was passed.

Minutes

A motion was then made and seconded that the report of the Nominating Committee be accepted. The motion was passed.

(Secretary's Note: The following reflects the reports of the various sections as to Chairman/Vice Chairman elected by the respective sections).

- I. Biological Sciences
Sam Campbell, UAH, '83
Robert MacGregor, UAB, '83
- II. Chemistry
Raymond Isbell, UNA, '83
Thomas Webb, AU, '83
- VI. Industry & Economics
William Stewart, UNA, '83
Dean Moberly, AUM, '83
- VIII. Social Sciences
Hines Hall, AU, '83
John Dunkelburger, AU, '83
- IX. Health Sciences
Walter Wilborn, USA, '83
Ellen Buckner, UAB, '83
- X. Engineering
John Cain, AU, '83
- XI. Anthropology
Brian Hess, UAB, '83
John Cottier, AU, '83

Dr. Welker then asked for the floor. He pointed out that due to Dr. O'Masta's election to the office of Counselor to the AJAS, a vacancy existed in the office of Vice Counselor. President Emerson called for nominations for that position. Dr. B.J. Bateman's name was placed in nomination. There being no further nominations, a motion was made, seconded, and passed that the nominations be closed. Dr. Bateman of Troy State University was elected Associate Counselor to the AJAS.

- 11) President Emerson then asked for a report from the Committee for the Study of Educational Requirements for Science Teachers. Dr. Barker, Committee Chairman, indicated that a report would not be in order at this time due to the lack of and/or varied responses received as a result of the Committee's inquiries.

Minutes

- 12) President Emerson then asked for consideration of new business. Mr. R.R. Chowdhury requested that thought be given to establishment of a Computer Science Section of the Academy. Dr. Barker suggested that perhaps it would be better to integrate such a group into an existing section of the Academy. After further discussion, the matter was referred to the Executive Committee for consideration at the Fall, 1981 Executive Meeting.

There being no further business before the Academy, the meeting was adjourned by President Emerson.

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CALIBRATING NEUTRON SURVEY METERS WITH
A MEASURED THERMAL NEUTRON FLUX¹

G. M. McCormick, M. Nomai², R. N. Yerby, and D. L. Hollis
*The University of Alabama
University, AL 35486*

Abstract. Efforts to provide neutron survey meter calibration by means of more direct instrument response to neutrons of measured energies are reported here. Neutrons from a PuBe source are partially thermalized by a surrounding paraffin sphere to produce neutrons with energies covering the thermal-fast range. Thermal flux from the paraffin neutron source is determined from activated indium foils placed at increasing distances from the sphere. Calibration is effected by comparing meter readings at a point with the known flux at that point.

BACKGROUND

Calibrational procedures for neutron survey meters may vary according to the manufacturers. For example, one survey meter is calibrated indirectly by electronic means, while another is calibrated with fast neutrons from a particular source of specified activity. As a consequence, there can be doubt that calibrations accomplished according to the instruction manuals of the above instruments are as direct as desired, leaving in question, for the extreme case, whether or not a given meter is actually responding to neutrons at all. But, more practically, there can be concern about the instrument's response to neutrons of a particular energy spectrum, specifically thermal neutrons. A method is described here in which attempts are made to more directly calibrate neutron survey meters with neutrons from a fast neutron source of virtually any good-sized activity. This procedure entails the moderation of some of the fast source neutrons so that the survey meter's response to thermal neutrons can be compared to the measured thermal spectrum. The result provides more assurance that an instrument is actually detecting neutrons in a given energy range with a reasonable accuracy.

GENERAL NEUTRON SURVEY METER OPERATION

Of the two instruments tested, the detector for one is a boron lined proportional counter, while the other detector is a BF₃

¹Manuscript received 3 February 1981; accepted 30 July 1981.

²IAEC Fellow from Zambia.

gas-filled proportional tube enriched to 96% in ^{10}B . Different modes of operation are available. These are effected by means of an attachable moderator (polyethylene or paraffin) and a cadmium absorber shield. The moderator and shield are cylindrical in shape concentric to the detector, which may be attached separately or jointly. The absorption cross section of ^{10}B follows a $1/v$ pattern for neutrons with energies ranging from zero up to about 30 keV (100 eV for natural boron); therefore, for detectors containing ^{10}B , the absorption rate is independent of the energy distribution as long as the $1/v$ upper limit is not exceeded⁽¹⁾. In this discussion, thermal neutrons are defined to have energies from 0 to 5 kT, and for room temperature the maximum thermal energy is 0.125 eV. Epithermal neutrons are defined with energies varying from thermal to the upper $1/v$ limit, and all neutrons above the epithermal maximum are designated as fast neutrons.

The bare proportional detector measures thermal and epithermal neutrons, mode (1); the detector surrounded with cadmium measures epithermal neutrons only, mode (2); the detector surrounded with moderator alone responds to thermal, epithermal, and fast neutrons, mode (3); and the detector surrounded with moderator and cadmium responds to epithermal and fast neutrons, mode (4). Actually, cadmium absorbs most neutrons with energies less than 0.40 eV, and it passes most neutrons above that energy; but deviations from the above statements are minor. Thermal neutrons are obtained from [mode (1) - mode (2)] and from [mode (3) - mode (4)]. Fast neutrons result from [mode (4) - mode (2)]. Boron detectors will respond to gamma rays, but with proper compensating electronics, which exists in the instruments examined, sensitivity to gamma radiation is negligible.

NEUTRON SOURCE AND THERMAL NEUTRON FLUX

A calibrated PuBe neutron source releasing 2.09×10^6 neutrons/s is used as the source of fast neutrons. This emission rate includes a correction for increased neutron activity with time due to small amounts of ^{241}Pu in the source⁽²⁾. The PuBe is contained within a stainless steel cylinder with outside dimensions of 2.59 cm diameter and 3.28 cm length. Neutron sources of this type have an energy spectrum reaching as high as 10.5 MeV with an average energy of about 3.5 MeV⁽³⁾. To provide a neutron flux with all three energy ranges, the neutron source is placed at the center of a nearly spherical paraffin volume of insufficient radius, 10.6 cm, to assure thorough thermalization. A cylindrical plug of plastic and paraffin placed on top of the source completes the enclosure of the PuBe with moderating material. The sphere is suspended with a nylon harness, rope, and pulley to allow variable vertical positioning. See Figure 1.

Neutrons leaving the paraffin sphere consist of those with non-thermal energies traveling mostly in a direction normal to the surface and of neutrons which have been thermalized within the sphere. The "thermal" neutrons outside of the paraffin probably have random velocities in all directions except for the one perpendicular to the surface, since the neutron density decreases with radial distance. Further complications result from the rectangular ground-floor room in which the

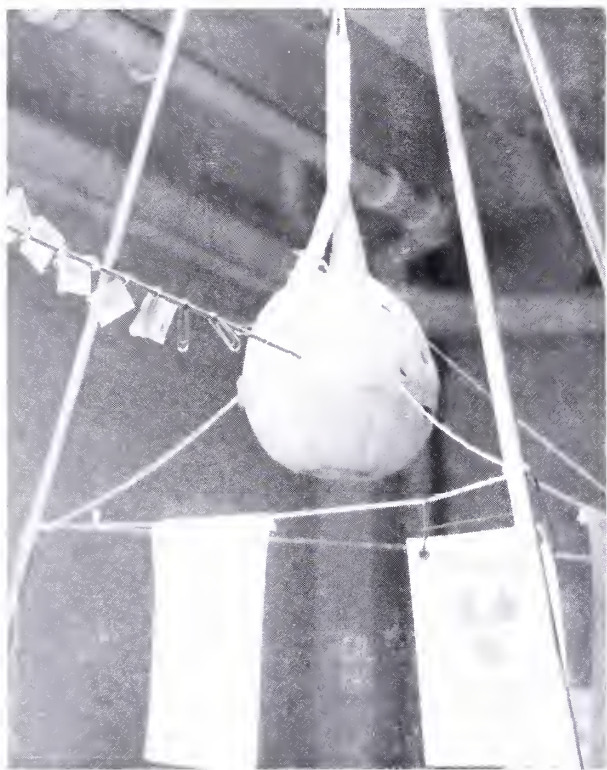


Figure 1. Paraffin sphere with PuBe at center and foils in place with vertical orientation.

source is located. Its dimensions are approximately $4\text{ m} \times 5.7\text{ m} \times 3.4\text{ m}$, and all surfaces are concrete except steel doors in the north end and southwest corner. The center point of the neutron source is about 1.64 m from the floor, 1.76 m from the ceiling, 2.7 m from the north end, and 1.8 m from the east wall. There are projections into the room space near the source because of a metal hood and various boxes and equipment on the floor. Neutron reflections from these surfaces influence the neutron velocity distributions for virtually all energies, although the reflected components are not too significant near the sphere. As long as the survey meter probe and the indium foils used for flux measurements are exposed to the same conditions in regard to reflected neutrons (i.e. open doors, moved boxes or equipment, or . . .), the relative comparisons for calibrational purposes are meaningful.

Thermal neutron flux profile as a function of distance from the center of the paraffin source is obtained by means of indium foil

Calibrating Neutron Survey Meters

activation with and without cadmium covers. The former is counted first to avoid significant residual activation from bare foil activation compared to cadmium covered foils. Detection of any inherent indium activity is made by counting the foils before activation, but no appreciable difference from background is detected. Saturation activity is assured by leaving the foils in the neutron field for at least 24 hours. By delaying 4 minutes from the instant of removal from the neutron field to the time of counting, only the 54.125 m state of ^{116}In is observed. This state beta-decays with maxima MeV energies E_m and percent occurrences of 1.00 (51), 0.37 (28), and 0.60 (21)(4). Each foil side is counted for 20 minutes with an end window proportional counter. Background counts for at least 10 minutes and calibration readings from ^{204}Tl of 5 minutes are taken before and after each measurement period. The saturation count rates $A_S(r)$ and $A_{SC}(r)$ of activated indium foils bare and with cadmium covers are calculated from(1)

$$A_S(r) = \lambda [C(r) - B] / F\epsilon(1 - e^{-\lambda t_a})(e^{-\lambda t_1} - e^{-\lambda t_2}) \quad (1)$$

where $\lambda = \ln 2 / (54.125)(60\text{s})$; $C(r)$ is the number of counts recorded between t_1 and t_2 , which are measured from the time of foil removal from the neutron field; B is the background counts for 20 minutes; F is the fraction of foil surface exposed to neutron bombardment; ϵ is the overall efficiency of the counting system, and t_a , the activation time, is infinite for all practical purposes. Distance r in cm is measured from the source center, even though the thermal flux peaks in the paraffin at about 2 cm from the PuBe (5). This does not lead to any inconsistencies as long as the convention is maintained, because both foils and survey meters are subjected to the same flux when placed at the same geometric location and orientation relative to the source.

For thin foils F is one, but the large thermal absorption cross section of indium makes it difficult to fabricate a totally thin foil of this element. However, about 90% of thermal neutrons pass through a 0.1 g/cm^2 indium foil without being absorbed. This is approximately the thickness of the foils used. Consequently, a rough estimate of 0.95 is chosen for F . (Credit is given to the reviewers for this value.)

Efficiency of the counting system is represented as

$$\epsilon = R f_b f_s \quad (2)$$

The quantity R accounts for the geometry factor, counter beta efficiency, multiple-count factor, dead-time correction, and correction for absorption between source and detector interior. Backscattering and foil beta self-absorption corrections are represented by f_b and f_s . An approximate value for R is determined from measured count rates (minus background) of a ^{204}Tl (0.7634 MeV beta maximum) source of known strength which resembles the indium beta radiations in activity and energy:

$$R = (\text{Tl-CR measured}) / (\text{Tl-CR actual}) \quad (3)$$

Calibration of the thallium source was determined by the manufacturer with 2π geometry similar to the detection geometry used here. Values for R are given in Tables 1 and 3. All foils are counted with essentially the same backscattering conditions as the thallium source (0.5 cm aluminum backing), and a value of 1.20 is used for $f_b^{(6)}$. The self-absorption factor is obtained by two methods, which will be described.

Since the end window detector responds to betas from only one foil side at a time, both sides are counted separately and added to get the complete foil activity. Consequently, there are two waiting times t_1 for each foil: 4 minutes for the first side, top, to be counted, and 25 minutes for the other side, bottom. One minute is allocated to turning the foil over. In both cases, $(t_2 - t_1)$ is 20 m. After combining factors and correcting for decay, the saturated activities in dps for the two foil sides, top and bottom, bare and with cadmium covers are, without f_s :

$$A_s^t(r, t_1 = 4m) = 8.72(10^{-4})[C^t(r) - B]/R \quad (4)$$

$$A_s^b(r, t_1 = 25m) = 1.14(10^{-3})[C^b(r) - B]/R \quad (5)$$

The beta self-absorption factor is found empirically by activating three sets of bare indium foils at the same point in the neutron field⁽⁷⁾. Different foil thicknesses are effected by superimposing foils on top of each other, as indicated in Table 1. Activity of a foil is proportional to its mass irrespective of thickness; therefore, to display the effects of foil thickness, the specific activities (activity per mass) are plotted as a function of foil-set mass. These activities are computed from equations (4) and (5) with the data listed in Table 1. Mass M is used instead of thickness because the two are proportional to each other for constant foil areas. Curve (b) in Figure 2 shows that the extrapolated value of (A_s/M) as M approaches zero is about 50 cps/g. With this value, $f_s = (A_s/M)/50$ is evaluated and drawn as curve (a) of the same figure. The self-absorption factor obtained in this manner is applied to the sum of the activities of the two foil surfaces, equations (4) and (5), in computing the total saturated activity.

Another way to obtain f_s is with the following expression^(1,8),

$$f_s = (1 - e^{-\mu s})/\mu s \quad (6)$$

For each of the three indium betas, the mass absorption coefficient μ in cm^2/g is obtained from Equation (7), with E_m in MeV as previously given⁽⁹⁾,

$$\mu = (17/E_m^{1.14}) \quad (7)$$

Calibrating Neutron Survey Meters

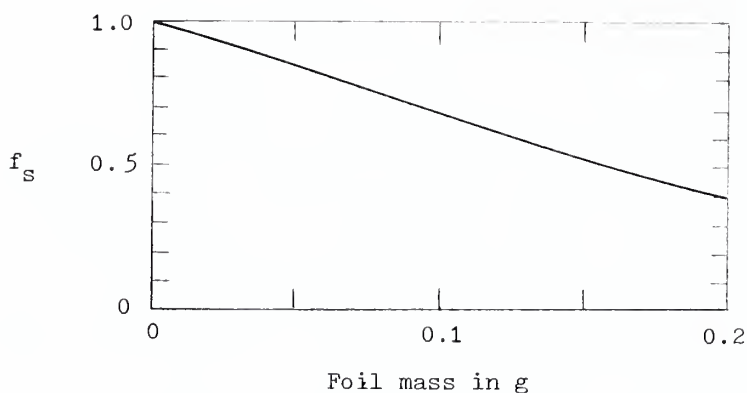


Figure 2a. Beta self-absorption factor f_s as a function of foil mass, or thickness, where $f_s = (A_s/M)/50$.

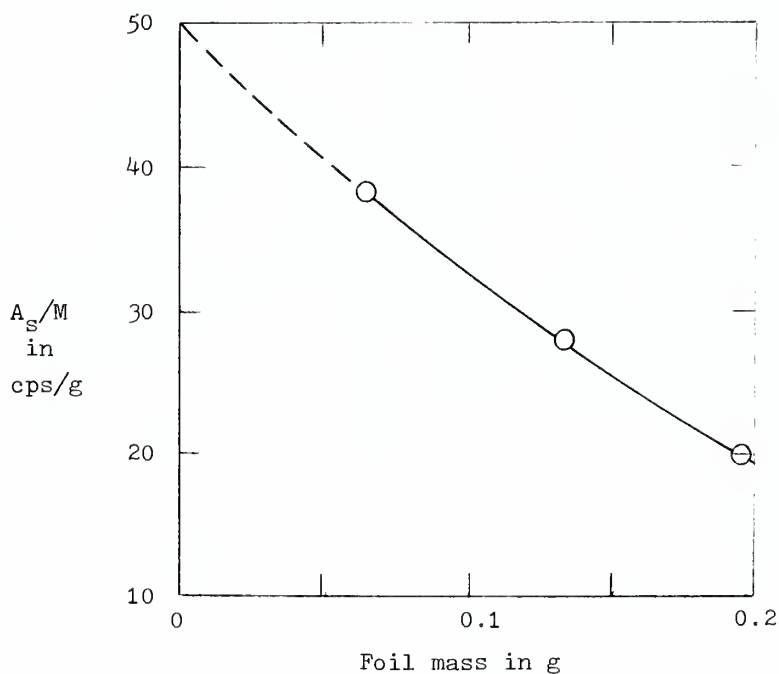


Figure 2b. Specific activities of different foil masses located at the same place in the neutron field.

Table 1. Self-absorption factor empirical data for curve (b) of Figure 2.

*Foil Nos. mass, g	C^t	counts/20 m		R	A_S^t/M A_S^b/M	cps/g A_S/M
		C^b	B			
2 0.06560	910	708	352 352	.355 .355	20.9 17.4	38.3
2 + 4 0.13177	1181	864	341 341	.360 .360	15.4 12.6	28.0
6 + 8 + 10 0.19624	1274	866	341 341	.360 .360	11.5 8.5	20.0

* All foils are bare and are placed at 19.8 cm from the paraffin source center with vertical orientation.

Foil thickness s is in g/cm^2 . Thicknesses of the foils are calculated from measured masses, mass density, and area based on 3/8 inch diameter; see Table 2. Self-absorption coefficients are computed for each foil from the following formula,

$$f_s^i = 0.51 f_{s1}^i + 0.28 f_{s2}^i + 0.21 f_{s3}^i . \quad (8)$$

The values for each foil are given in Table 2. As computed with this procedure, f_s is approximately half of an empirical value, implying that the theoretical coefficient corrects for 2π geometry and is, therefore, applied to the activity of one foil surface to get the total saturated activity. The final flux computations with these two methods for finding f_s are fairly close to each other, and the differences appear to decrease as foil thickness increases.

Thermal neutron flux at a given distance from the paraffin sphere containing the PuBe source in neutrons/ cm^2s is found from⁽¹⁾

$$\phi(r) = n \bar{v} = 1.128 [A_S(r) - F_{Cd} A_{Sc}(r)] / N_T \sigma_{oa} g_a(T) (T_o/T)^{1/2} . \quad (9)$$

The coefficient in this equation, resulting from averaging over the Maxwell-Boltzmann distribution, may be questioned, but since there probably is randomization of two velocity components its retention is retained. Correction F_{Cd} for epithermal neutron absorption in the 20 mil thick cadmium covers used with vertically oriented foils is 1.07 for all but the two thicker foils which have a value of 1.09⁽¹⁰⁾. For the 10 mil thick covers used with horizontal foils, F_{Cd} is reduced by 0.04 in both cases. Total number of ^{115}In atoms N_T is $0.957 N_A M/A$; where the

Table 2. Self-absorption factor, theoretical.

$$^{115}\text{In}: \mu_1 = 17 \text{ cm}^2/\text{g}, \mu_2 = 19.9 \text{ cm}^2/\text{g}, \mu_3 = 30.4 \text{ cm}^2/\text{g}$$

Foil No.	Mass $\pm 0.00003 \text{ g}$	s^i g/cm^2	f_{s1}^i	f_{s2}^i	f_{s3}^i	f_s^i
1	0.06660	0.093	0.50	0.46	0.33	0.45
2	0.06560	0.092	0.51	0.46	0.34	0.46
3	0.06465	0.091	0.51	0.46	0.34	0.46
4	0.06617	0.093	0.50	0.46	0.33	0.45
5	0.12886	0.181	0.31	0.27	0.18	0.27
6	0.06551	0.092	0.51	0.46	0.34	0.46
7	0.06537	0.092	0.51	0.46	0.34	0.46
8	0.06420	0.090	0.51	0.47	0.34	0.46
9	0.06465	0.091	0.51	0.46	0.34	0.46
10	0.06653	0.093	0.50	0.46	0.33	0.45
11	0.13020	0.183	0.31	0.28	0.18	0.27
12	0.06555	0.092	0.51	0.46	0.34	0.46
13	0.06535	0.092	0.51	0.46	0.34	0.46
14	0.06721	0.094	0.50	0.45	0.33	0.45
15	0.06470	0.091	0.51	0.46	0.34	0.46

numeric is natural abundance; N_A is Avogadro's number, M is foil mass in grams, and A is 114.90388 g. The activation cross section σ_{0a} is $161 \text{ b}(4,11)$, and the indium non-1/v factor $g_a(T)$ at the average room temperature of 82°F is $1.021(12)$. With these values the thermal flux in $\text{n}/\text{cm}^2\text{s}$ simplifies to

$$\phi(r) = 1.39[A_s(r) - F_{Cd} A_{sC}(r)]/M. \quad (10)$$

A computer program facilitated the many calculations leading to the flux values.

Measured data with values for R and empirical f_s are listed in Table 3 along with computed specific activities. Since each foil has a different mass, best estimates of the foil activities are found from plots of the specific activities, which are given in Figure 3. Corresponding to standard deviation of the count rates, error bars for the curves are equal to the square roots of the specific activities plus an additional 10% to account for distance measurement errors ($\pm 0.2 \text{ cm}$) and coefficient inaccuracies. The specific activity profiles in Figure 3 are for foils with vertical and horizontal orientations. The vertical foils, as shown in Figure 1, should provide reasonably accurate thermal flux measurements close to the neutron source. In a completely thermalized system, foil orientation is immaterial, but this is not the case with the paraffin source surrounded by concrete. At the paraffin surface, neutrons with energies in the thermal range emanate normally to

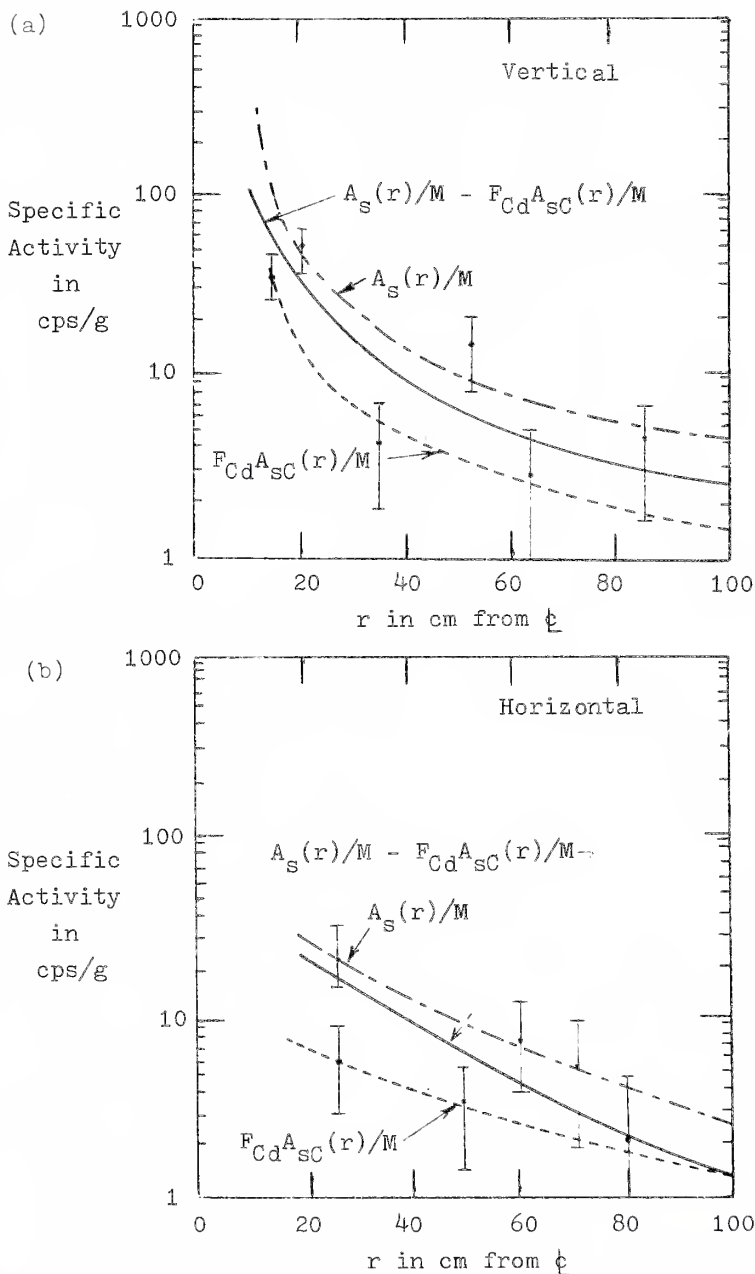


Figure 3. Specific activities with and without cadmium covers and their differences as a function of distance from neutron source center. (a) is for foils with vertical orientation, and (b) is for foils oriented horizontally.

Calibrating Neutron Survey Meters

Table 3. Measured data and computed specific activities.

Foil No. cm	Orient. Vert. Horiz.	C/20 m C ^{t/b} C _{Cd} ^{t/b}	B	R	f _s	cps/g A _S /M F _{Cd} A _{SC} /M
1 14.8	V	1326/1031 600/695	456 349	.354 .362	.77 .77	79 35
2 19.8	V	910/708	352	.355	.77	50
3 24.8	V	693/623 427/374	352 328	.355 .352	.77 .78	35 8.5
4 29.8	V	609/526	352	.355	.77	24
5 34.8	V	644/496 410/355	382 328	.360 .352	.59 .59	13 4.1
6 39.8	V	568/478	382	.360	.77	15
7 44.8	V	539/470 351/362	382 328	.360 .352	.77 .77	13 3.5
8 49.8	V	508/456	361	.353	.77	14
9 54.8	V	447/470 346/387	361 341	.353 .360	.77 .77	11 3.4
10 59.8	V	462/398	372	.359	.77	5.9
11 64.8	V	462/463 383/368	372 341	.359 .360	.58 .58	6.6 2.7
12 69.8	V	413/416	372	.359	.77	4.7
13 74.8	V	440/425	383	.355	.77	5.5
14 79.8	V	446/444	373	.359	.77	7.7
15 84.8	V	424/369	373	.359	.77	3.8
12 24.8	H	599/562 424/420	351 370	.368 .359	.77 .77	25 6.0
13 34.8	H	462/481 412/406	351 370	.368 .355	.77 .77	14 4.6
15 39.8	H	468/475 419/385	351 370	.368 .359	.77 .77	13 3.4

Table 3--continued

Foil No. cm \underline{C}	Orient. Vert. Horiz.	C/20 m $C_{t/b}^{t/b}$	B	R	f_s	cps/g A_s/M
		$C_{Cd}^{t/b}$				$F_{Cd} A_{sC}/M$
14	H	397/437	351	.368	.77	7.3
59.8		353/392	360	.367	.77	1.9
11	H	442/437	367	.367	.58	5.3
69.8		432/393	360	.367	.58	3.8
5	H	387/433	367	.367	.59	3.3
79.8		378/404	360	.367	.59	2.6

the surface, and their relatively large numbers overshadow reflected neutrons. The flux becomes more complicated away from the source. At large separations from the paraffin source, the "thermal" neutron flux consists of the superposition of different current density magnitudes. This can be represented as a horizontal current density magnitude, mainly from the paraffin source (measured by the vertical foils), and as a vertical current density magnitude due to neutrons reflected from the floor (1.64 m away) and from the ceiling (1.76 m away). Reflections from the walls are neglected, since the thin cylindrical meter detectors are oriented perpendicular to them, and the room ends are relatively far away. The vertical flux component is measured by indium foils supported as in Figure 1 except for horizontal orientation. It is our judgement that the reflected flux component becomes important for separation distances greater than about 60 cm. Thermal flux, taken as the sum of the above two components, refers to neutrons with energies in the thermal range. Table 4 lists the two components and the total thermal flux computed from equation (10). The curve for ϕ_{Th} appears in Figure 4 where comparisons are made for meter calibration purposes. An estimate of the overall accuracy of the thermal flux as determined here is $\pm 25\%$.

Table 4. Thermal flux vs separation.

cm \underline{C}	ϕ_V	$n/cm^2 s$ ϕ_H	ϕ_{Th}
15	96		96
20	53		53
40	15		15
60	6.8	6.3	13
80	4.3	3.1	7.4
100	3.8	1.7	5.5

Calibrating Neutron Survey Meters

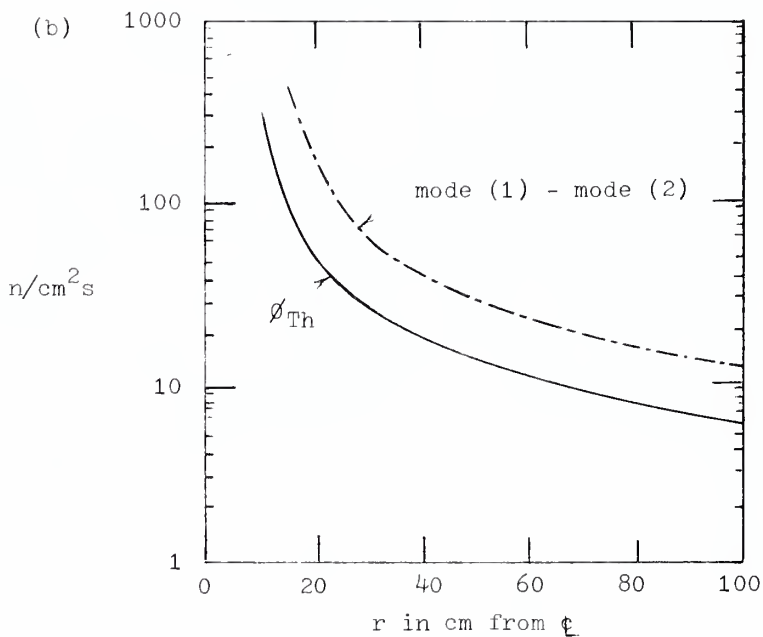
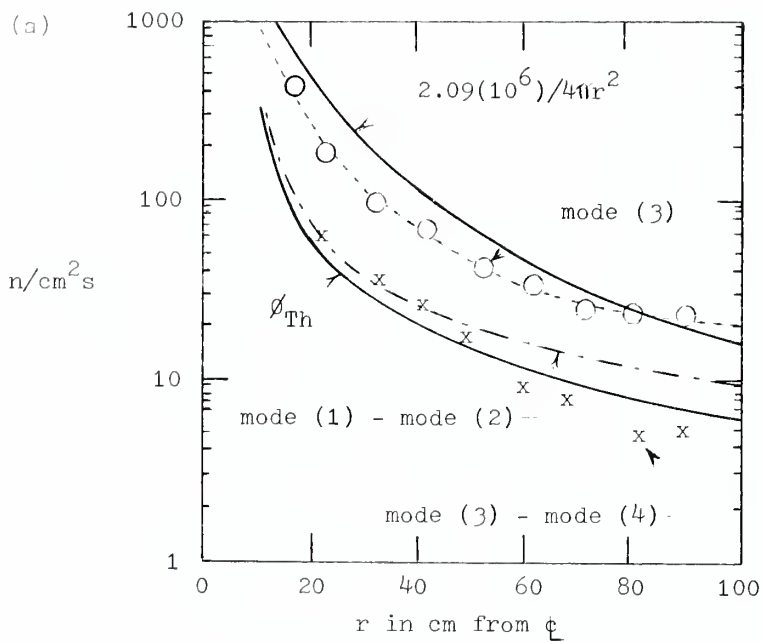


Figure 4. Neutron flux as a function of distance from neutron source center for: (a) meter (A), including total flux; and (b) meter (B).

METER CALIBRATION

Readings at varying distances from the source and modes of operation are taken with two instruments, (A) and (B), made by different companies. Counts per minute and flux (nv) are recorded from the lowest meter scale for best accuracy. For meter (A) the (nv) scale should be read only with the bare detector to get the approximate thermal flux; consequently, the cpm values are used here in determining the flux. A conversion number of $(3 \text{ n/cm}^2\text{s})/100 \text{ cpm}$ changes the count rates to thermal flux. After correcting for zero reading, the thermal flux response by meter (A) to the neutron field from the paraffin source is plotted in Figure 4(a). Plots of $(\text{source strength})/4\pi r^2$ and mode (3) from meter (A) are also shown in the same figure. The other instrument, (B), calibrated with fast neutrons by the manufacturer, does not have a cpm scale in some ranges, and it can only operate in modes (1) and (4). Mode (2) was effected, however, with the use of the cadmium shield from meter (A). The flux readings for this meter are multiplied by three, as stated in the manual, to get the actual thermal flux. This was done after subtracting the flux readings of mode (2), as shown in (b) of Figure 4.

CONCLUSIONS

The neutron source consisting of a known neutron emitter surrounded by a paraffin sphere provides an adequate supply of thermal neutrons and a useful number of non-thermal neutrons for purposes of meter calibration. Without reflections, thermal flux at a point external to the paraffin source would be the total number of thermal neutrons leaving the surface of the paraffin sphere per second divided by the spherical area concentric to the source center and passing through the given point. This is true as long as there are no moderation or losses in the intervening air. The above distribution is complicated in the real case by the presence of reflecting surfaces which also act to moderate non-thermal neutrons. The actual thermal flux at an external point from the source is not completely a thermal flux in the Maxwellian sense. Thermal flux is considered here as the flux of neutrons with energies in the thermal range even though there may not be total velocity randomization. Addition of the horizontal and vertical flux components appears to be justified after examining the profiles of (a) and (b) in Figure 4.

Comparisons of the measured flux from the foils with meter readings do provide assurances that the meters are responding to neutrons and especially to thermal neutrons. The latter assurance is gratifying in view of the indirect processes by which thermal neutrons are determined by both instruments. These procedures depend on factory calibration in terms of non-thermal neutrons and do not require the subtraction of mode (2), as indicated in the beginning of this paper. It is agreed, though, that this correction is not large and could be neglected for survey purposes. Even with mode (2) subtracted from mode (1), as in (a) and (b) of Figure 4, the thermal fluxes by both meters are greater than that of the foils, with meter (B) considerably larger. (This may be due to the enriched ^{10}B in the B-detector.) Again, for survey purposes it is better to be conservative (safer). Probably, $[\text{mode (1)} - \text{mode (2)}]$

provides the more accurate thermal flux measurement than [mode (3) - mode (4)], since there is greater absorption and moderation with the latter combination. The $1/r^2$ flux exceeds the total flux of mode (3); see (a) of Figure 4. This is due to absorption losses in the paraffin and other materials. The thermal flux from the foils (to a lesser extent) and meters tend to flatten at large distances from the source. This is also true with mode (3) of meter (A). Such a pattern is consistent with reflections in the closed room, and there also may be a tendency for the instruments to read constant values for low count rates.

Appreciation is extended to the reviewers for their constructive criticism.

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RELATIONSHIP OF HIGH AND LOW PSYCHOLOGICAL
STRESS ON SERUM CHOLESTEROL AND SERUM
LIPOPROTEIN CHOLESTEROL^{1,2}

Kennon T. Francis and Cathy Aymen
Division of Physical Therapy
University of Alabama in Birmingham
Birmingham, AL 35294

Abstract. The relationship between the two coronary heart disease risk factors--psychological stress and serum lipoprotein cholesterol--was investigated in 39 healthy men age 30 to 55. Subjects were divided into groups of "high" trait psychological stress and "low" trait psychological stress. Serum was analyzed for total cholesterol as well as the various lipoprotein cholesterol levels. There was no significant difference in any of the serum cholesterol values between the high and low trait psychological groups. Possible explanations for the contrasting results of this study with previous reports are included.

INTRODUCTION

Correctly identifying those individuals with a relatively high probability of developing coronary heart disease (CHD) is crucial in the attempt to decrease the incidence of mortality and morbidity due to this disease. Factors found to be associated with an increased incidence of CHD are hypertension (systolic blood pressure above 140) (17), elevated total serum cholesterol (above 250 mg/dl) (5, 17), cigarette smoking (5, 17), obesity (5, 17), and a family history of CHD (5, 17). Enthusiasm in having discovered these CHD risk factors should not obscure the fact that other CHD risk factors may exist. Psychological stress has often been implicated as a contributing factor in the development of CHD; however, it is not always included in the list of risk factors. The positive relationship between psychological stress and CHD has been supported not only by retrospective but prospective studies as well and is gaining in its acceptance as a CHD risk factor.

Stress and CHD

Stilten et al. (31) have demonstrated that aggression, anxiety, defensiveness, and seclusion are common personality characteristics identified in human subjects manifesting clinical and electrocardiographic signs of CHD. Stockmeirer (32) retrospectively studied the

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psychological aspects of subjects with CHD and found them to exhibit more anxiety, more depression, and less ability to concentrate than healthy controls. Other studies (16) have found that men with CHD scored significantly higher than men free of the disease on scales of anxiety and subjectively ranked themselves much more frequently under stress than male controls.

Medalie and Snyder (22) have reported that a three item anxiety index was prospectively associated with an increased incidence of angina pectoris. Likewise, coronary angiographic studies of individuals with atherosclerosis suggest that anxiety and depression may be associated with the atherosclerotic process. Zyzanski et al. (37) found that scores on anxiety and depression scales were significantly associated with the degree of the incidence of atherosclerosis in male subjects.

Lipoprotein Cholesterol and CHD

In addition, psychological stress has been linked with an increase in serum cholesterol. Peterson et al. (25) and Clark et al. (9) have found that total serum cholesterol levels rose in anticipation of a stressful event and during the event itself. This response is true for cardiac patients as well (7).

Recently, evidence was accumulated indicating that, in addition to the concentration of total cholesterol, the manner in which cholesterol is distributed or transported in the blood may be associated with the risk of developing CHD (2, 10, 11). Cholesterol is known to be distributed unequally among three lipoprotein fractions: high-density (HDL), low-density (LDL), and very-low density (VLDL) lipoproteins (12, 20). It has been demonstrated that the cholesterol carried in the HDL fraction is not harmful but in fact appears to be protective against the development of CHD (25, 33). The effect of such factors such as anxiety, depression, and hostility on this fraction of lipoprotein has not been defined.

Even though the two CHD risk factors--psychological stress and serum lipoprotein cholesterol--have individually been shown to be related to the pathological state of CHD, there is a paucity of information pertaining to the relationship between these two variables. This is especially true in individuals who have natural high trait anxiety indexes. Therefore, the purpose of this study was designed to study the relationship of the various lipoprotein cholesterol levels in subjects who exhibit high psychological stress as defined as high trait anxiety hostility and depression or low psychological stress as defined as low trait anxiety hostility and depression.

METHOD

Subjects

Thirty-nine normal male subjects, 30 to 55 years of age with no previous history of CHD, were selected from a population of faculty and employees from the University of Alabama in Birmingham and from

businessmen belonging to local organizations in the Birmingham area. The subjects were selected from a group of 63 volunteers on the basis of their scores on two written psychological stress examinations. The two written psychological stress examinations used as a screening device were the State-Trait Anxiety Inventory (STAI) developed by Spielberger et al. (30) and the Multiple Affect Adjective Check List (MAACL) developed by Zuckerman et al. (27).

Based on scores obtained on the STAI and the MAACL, subjects were categorized into a high psychological stress group and a low psychological stress group. Subjects ($n = 20$) that were selected for the high psychological stress group had to score higher than one standard deviation (SD) above normative scores on both the STAI trait scale (30) and the MAACL trait scales (36). Likewise, subjects ($n = 19$) selected for the low psychological stress group had to score one SD below normative scores on the STAI and MAACL trait scales. The use of one SD insured assessment of individuals on the ends of the psychological scales.

A brief medical history was obtained from all subjects by use of a questionnaire seeking information concerning age, race, height, weight, personal history of CHD, alcohol consumption, dietary habits, cigarette smoking, physical activity, occupation, and physical activity associated with occupation.

Lipid Analysis

All subjects reported to the physiology laboratory in the fasted state between 7 and 9 a.m. of the experimental day. The written tests were administered and blood samples were drawn. Serum lipoprotein cholesterol was separated into the various serum HDL cholesterol, LDL cholesterol, and VLDL cholesterol subfractions according to the procedures by Chung et al. (8). Total serum cholesterol, the serum lipoprotein cholesterol subfractions, and the triglycerides were measured by continuous-flow analysis according to the Lipid Research protocol (19) with the use of the Libermann-Burchard Reagent for cholesterol and a variation of the Wahlefeld procedure for triglycerides (3).

Statistics

As most of the demographic variables examined in this study had continuous distributions, mean scale scores among persons classified as high stress were compared with persons classified as low stress by Student's *t*-test, using the more conservative assumption that the variances of the group were unequal. The statistical significance of the differences between the means for the lipid and lipoproteins were also determined by the two tailed Student's *t*-test. Pearson correlational coefficients were calculated for comparisons of the two different psychological test measurements of anxiety, hostility, and depression.

RESULTS

Table 1 presents the mean State-Trait Anxiety Inventory (STAI) and the Multiple Affect Adjective Check List (MAACL) scores of the total

Stress and Serum Cholesterol

Table 1. The mean psychological stress scores (\pm S.E.) for the high and low psychological stress groups.

	STAI	MAACL		
	Trait Anxiety	Anxiety	Depression	Hostility
High Psychological Stress Group n = 20	46.8 ± 2.0	10.3 ± 0.6	17.2 ± 1.2	9.6 ± 0.7
Low Psychological Stress Group n = 19	27.3 ± 0.6	2.2 ± 0.5	6.1 ± 0.7	3.9 ± 0.5
Normative Psychological Scores (ref 23, 27)	38.22 ± 0.45	6.30 ± 0.40	13.60 ± 0.69	7.20 ± 0.38

high and low psychological stress groups for the three highly interrelated mood and feeling parameters of trait anxiety, hostility, and depression. Table 1 reveals that the goal of attaining two distinctly different psychological stress groups was attained.

The correlational analysis and significance levels between the psychometric parameters of trait anxiety, depression, and hostility as measured by the MAACL ranged from 0.741 to 0.877. The parameters of trait anxiety, depression, and hostility as measured by the MAACL were significantly ($p \leq 0.001$) correlated with each other as well as significantly ($p \leq 0.001$) correlated with the trait anxiety parameter as measured by the STAI.

Several factors such as sex (35), weight (15), personal history of CHD (16), alcohol consumption (1, 23), cigarette smoking (4, 15, 35), dietary habits (24), and exercise (3, 36, 37) have been shown to influence lipid and lipoprotein cholesterol parameters. Because of such a wide diversity of external influences on lipid and lipoprotein cholesterol parameters, it was essential to determine if the two populations were dissimilar.

Statistically, there was no significant difference in any of the categories questioned on the medical history form between the high psychological stress group and low psychological stress group (Figure 1, 2). The average height was 180.4 cm and the average weight was 85.8 kg for both groups combined. Ninety percent of the high psychological stress individuals and 85% of the low psychological stress individuals had some type of college degree (BA, BS, MA, MS, PhD, or MD). Annual income for both groups ranged from less than \$4,999 to greater than \$40,000 with a mean of \$28,000.50 for both groups combined. The mean alcohol consumption for the high psychological stress group was 6 drinks per week and for the low psychological stress group, the mean alcohol consumption was

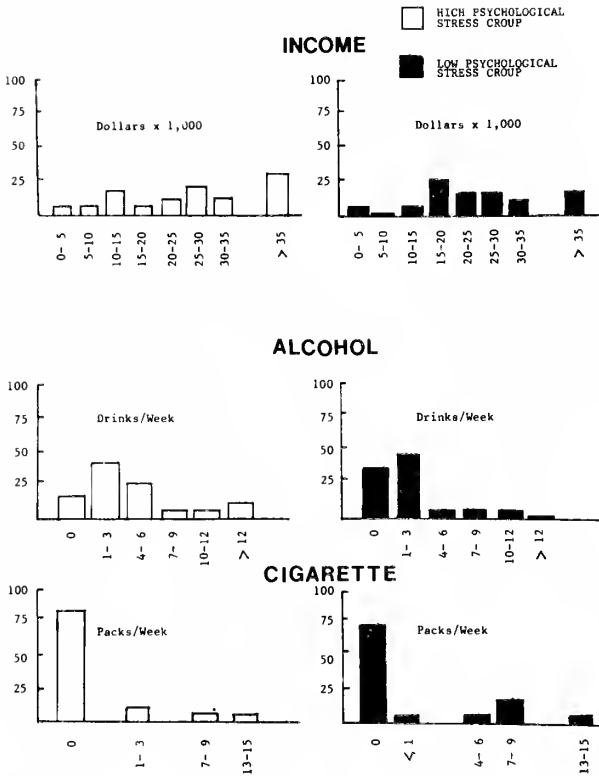


Figure 1. Bar graphs showing percent distribution of income, alcohol consumption, and cigarette smoking in the high and low psychological stress groups.

5 drinks per week. The majority of the individuals in both groups were non-smokers and had no unusual dietary habits. Both groups exhibited a wide range of occupations with the majority being in education or medicine. Eighty-five percent of the high psychological stress individuals and 79% of the low psychological stress individuals indicated that their occupation did not involve a good deal of physical activity.

Table 2 presents the mean (\pm S.E.) parameters of total serum cholesterol, total serum triglycerides, and the various serum lipoprotein cholesterol parameters in the high psychological stress and the low psychological stress groups. There were no significant differences in the absolute values of total serum cholesterol, total serum triglycerides, the various lipoprotein cholesterol subfractions, or in the various

Stress and Serum Cholesterol

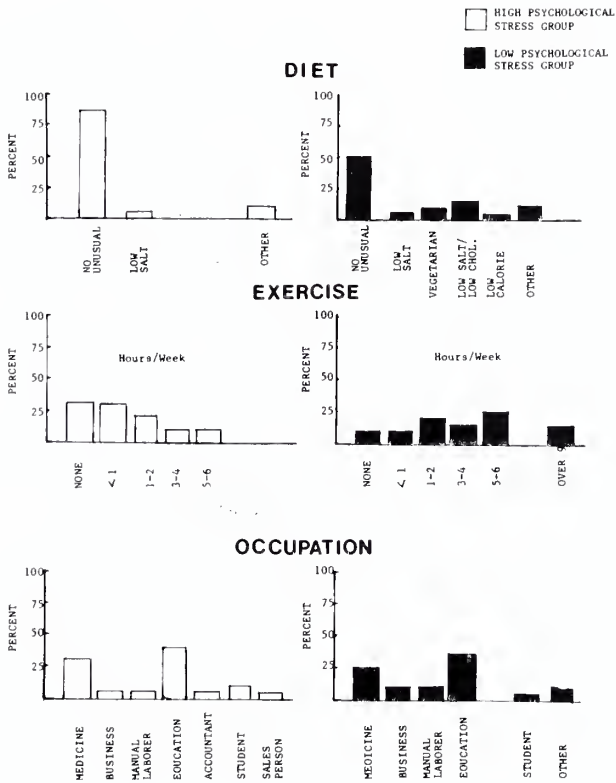


Figure 2. Bar graphs showing percent distribution of dietary habits, exercise, and occupation in the high and low psychological stress groups.

ratios of serum lipoprotein cholesterol to HDL cholesterol when the high psychological stress group was compared to the low psychological stress group.

DISCUSSION

In an attempt to explore the risk factors associated with coronary heart disease (CHD), the relationship between psychological stress and serum lipid and lipoprotein cholesterol absolute levels and the respective ratios of serum lipoprotein cholesterol to total serum cholesterol was examined.

The subjects utilized in this study were very similar in all respects as evidenced by the demographic data: comparison of the trait

Table 2. Mean lipid and lipoprotein parameters (\pm S.E.) in the high and low psychological stress groups.

	High Stress Group	Low Stress Group
LIPID PARAMETERS (mg/dl)		
Total Serum Cholesterol	194.7 \pm 9.1	182.6 \pm 7.2
HDL Cholesterol	48.1 \pm 2.7	45.6 \pm 3.4
LDL Cholesterol	108.7 \pm 7.3	100.4 \pm 3.4
VLDL Cholesterol	27.8 \pm 4.6	24.1 \pm 4.0
Triglycerides	137.6 \pm 19.2	132.7 \pm 29.2
RATIO OF LIPID PARAMETERS (%)		
HDL Cholesterol/ Total Serum Cholesterol	25.9 \pm 2.0	25.0 \pm 1.6
LDL Cholesterol/ Total Serum Cholesterol	54.9 \pm 1.5	54.9 \pm 2.7
VLDL Cholesterol/ Total Serum Cholesterol	13.9 \pm 2.2	13.0 \pm 2.0
HDL/LDL Cholesterol	44.3 \pm 3.7	45.4 \pm 3.7

anxiety, hostility, and depression scores of the high psychological stress group was clearly delineated from the low psychological stress group (Table 1). Therefore, the initial goal to study a set of subjects very similar except in their extremes of trait anxiety, hostility, and depression was attained. This was essential if these characteristics' effects on blood lipids was to be ascertained.

Previous studies (9, 10, 21, 26) indicate that an elevated level of total serum cholesterol is correlated with acute periods of anxiety. Likewise, the coronary-prone behavior pattern, sometimes called Type A behavior pattern, has been significantly correlated with an elevated level of total serum cholesterol (27). However, this relationship was not reflected in the present study (Table 2). The mean total serum cholesterol level obtained in the high psychological stress group was not significantly different from the mean level obtained in the low psychological stress group.

The majority of studies that examined the association between psychological stress and serum lipid cholesterol parameters failed to record the various lipoprotein cholesterol subfractions and their relationship to total serum cholesterol. However, in a previous study (11) the various lipoprotein cholesterol absolute values and their respective ratios have been examined in association with psychological stress. Francis (11) has found that the elevations in total serum cholesterol coinciding with peak periods of psychological stress were primarily reflected in elevations in LDL cholesterol rather than in the HDL cholesterol subfraction. HDL cholesterol to total serum ratio has been suggested to be one of the most powerful predictors of risk of developing CHD. Subsequently, Francis (11) found that the ratio of HDL cholesterol

to total serum cholesterol decreased during periods of psychological stress. Contrary to the above studies, this study found no significant differences in the serum lipoprotein cholesterol absolute values, the serum lipoprotein cholesterol to total serum cholesterol ratios, or the HDL/LDL cholesterol ratios when comparing the high psychological stress group to the low psychological stress group.

It must be concluded that, in the present study, psychological stress or the components of trait anxiety, depression, and hostility as measured by the STAI and MAACL have no effect upon the various serum lipid and lipoprotein parameters in this situation of test determined situation.

The major problem that consistently arises in stress research is the lack of consensus on a precise definition of stress as well as an integrative framework which can explain the majority of research results in a logical theoretical manner. Definitions of stress have focused upon the stimulus (34), response (29), or interactional elements (18) of the process wherein an organism encounters a situation and reacts to it. Traditionally, a "stressor" has been a specific stimulus in the transaction and the "stress response" the organism's relatively non-specific physiological response. For example, is the response of serum cholesterol to anticipation of a possible painful event. Serum cholesterol has been reported to significantly rise in the anticipation of the exposure to extreme cold (20) or the anticipation of surgery (28). This study, however, focused on the "chronic" relationship or trait characteristics of high and low psychological stress on serum cholesterol parameters. It appears that it may not be the chronic high or low psychological stress personality that influences the lipid and lipoprotein cholesterol parameters, but how these two types of individuals perceive and react to "acute" stress. Additional studies are needed to ascertain if differences really exist in perception of stress or reaction to various acute stress conditions between the chronic low psychological stress individual and the chronic high psychological stress individual.

It is also possible that measurements of serum lipid and lipoprotein cholesterol parameters on a random, cross-sectional basis as was performed in this study may not be reflective of the true physiological response to psychological stress that occurs in an individual throughout his daily experiences. External stress imposed upon an individual varies from hour to hour and from day to day and perhaps since blood samples were collected between 7:00 a.m. and 9:00 a.m., the peak stress portion of the work day had not yet begun. Also, because of the population size, these subjects may have or have not, by chance, been influenced by external stress on this particular day.

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ON NORMAL APPROXIMATION OF SIMPLE LINEAR COMBINATIONS¹

Saeed Maghsoodloo and James N. Hool
Department of Industrial Engineering
Auburn University, AL 36849

INTRODUCTION

This paper deals with application of the general methodology developed by Hool and Maghsoodloo [3] to determine the minimum number of identically and independently distributed random variables (RV's), n_{\min} , needed in the simple linear combination (SLC) $S_n = X_1 + X_2 + \dots + X_n$ in order that the distribution of S_n is satisfactorily approximated by a normal density function. In particular, the methodology is applied separately to SLC's of the following nine RV's: negative binomial, binomial, Poisson, geometric, gamma, uniform, exponential, beta and triangular. The approach involves determining for each type of RV its standardized third and fourth moments in terms of its distribution parameters, then applying the methodology to determine how n_{\min} varies as a function of distribution parameters and desired accuracy level of the normal approximation.

NORMAL APPROXIMATION METHODOLOGY SUMMARY

The k th moment of a discrete RV X about a real number C is defined as

$$M_k(X) = E(X-C)^k \quad (1)$$

where E denotes the expected value operator. In statistics, the only moments of interest are those about the origin ($C = 0$) and about the mean ($C = \mu$), and typically for $k = 1, 2, 3, 4$. The k th moment about the origin and the mean μ are, respectively, denoted by $\mu_k' = E(X^k)$ and

$$\mu_k = E(X-\mu)^k. \quad (2)$$

It should be noted that the first moment about the origin is simply the mean while the second moment about the mean is the variance of X . It can be shown (through a binomial expansion of (2)) that

$$\mu_1' = E(X-\mu) = 0$$

$$\mu_2 = E(X^2) - \mu^2 = \sigma^2$$

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$$\mu_3 = E(X^3) - 3\mu E(X^2) + 2\mu^3$$

$$\mu_4 = E(X^4) - 4\mu E(X^3) + 6\mu^2 E(X^2) - 3\mu^4. \quad (3)$$

Furthermore, the standardized third and fourth moments of X are denoted by α_3 and α_4 , where

$$\alpha_3 = \mu_3/\sigma^3$$

and

$$\alpha_4 = \mu_4/\sigma^4.$$

Both μ_3 and α_3 measure skewness of X . When $\alpha_3 > 0$ the distribution of X is skewed to the right, and $\alpha_3 < 0$ implies the distribution is skewed to the left. For a symmetric distribution (such as the normal), $\alpha_3 = 0$.

μ_4 and α_4 measure the kurtosis¹ of a distribution. Curves, such as the normal, for which $\alpha_4 = 3$ are called mesokurtic. Those having $\alpha_4 > 3$ are called leptokurtic; those having $\alpha_4 < 3$ are called platykurtic.

Consider now the SLC,

$$S_n = X_1 + X_2 + \dots + X_n, \quad n = 2, 3, 4, \dots \quad (4)$$

where X_1, X_2, \dots, X_n are identically and independently distributed RV's with mean μ , variance σ^2 , third moment μ_3 , fourth moment μ_4 , standardized third moment α_3 , and standardized fourth moment α_4 . The mean and variance of S_n are

$$E(S_n) = n\mu$$

and

$$V(S_n) = n\sigma^2$$

respectively.

The third and fourth moments of S_n are derived [3] to be

$$\mu_3(S_n) = n\mu_3$$

and

$$\mu_4(S_n) = n\mu_4 + 3n(n-1)\sigma^4.$$

The standardized third and fourth moments of S_n are, respectively,

¹Kurtosis of a distribution refers to both the peakedness in the middle and thickness at the tails.

Normal Approximation of Simple Linear Combinations

$$\alpha_3(S_n) = \frac{\alpha_3}{\sqrt{n}} \quad (5)$$

and

$$\alpha_4(S_n) = \frac{\alpha_4 - 3}{n} + 3. \quad (6)$$

Convergence of $\alpha_3(S_n)$ and $\alpha_4(S_n)$ to their normal equivalents of zero and three, respectively, is next examined. Given small positive real numbers ϵ_3 and ϵ_4 (say ϵ_3 & $\epsilon_4 \leq .15$), values of n_3 and n_4 are sought such that

$$|\alpha_3(S_{n_3})| \leq \epsilon_3, \quad (7)$$

and

$$|\alpha_4(S_{n_4}) - 3| \leq \epsilon_4. \quad (8)$$

Then the minimum number of X 's for the normal approximation to be satisfactory is $n_{\min} = \max(n_3, n_4)$. For a SLC, relations (5), (7), (6), and (8) lead to

$$n_3 \geq (\alpha_3/\epsilon_3)^2 \quad (9)$$

and

$$n_4 \geq \frac{|\alpha_4 - 3|}{\epsilon_4}. \quad (10)$$

It is clear from (9) and (10) that n_3 , n_4 and hence n_{\min} are functions of only α_3 , α_4 , and specified values of ϵ_3 , ϵ_4 . The remainder of this paper deals with the examination of how n_{\min} varies as a function of RV parameters and ϵ_3 , ϵ_4 .

ANALYSES OF DISCRETE DISTRIBUTIONS

Four classical discrete RV's are examined, viz. the negative binomial (Pascal), the binomial, the Poisson, and the geometric. These distributions appear in most basic probability texts such as [2], hence they are not discussed in detail here. Although the expressions for their α_3 , α_4 are well documented in the literature of statistics, they are derived, for sake of illustration, in the case of the negative binomial distribution using the RV's moment generating function (mgf). Then, expressions for n_3 , n_4 using (9) and (10) are developed and subsequently examined to determine their behavior as a function of distribution parameters. The approach is illustrated in detail for the negative binomial, and results are summarized in Table 1 for the other discrete distributions.

The Negative Binomial (Pascal) Distribution

The pdf of the negative binomial distribution is

$$p(r, x) = \begin{cases} \binom{x-1}{r-1} p^r q^{x-r}, & r \geq 1, \\ & x = r, r+1, \dots \end{cases} \quad (11)$$

where $q = 1-p$, p is the probability (pr.) of success for each trial of a Bernoulli process and $p(r, x)$ is the pr. that the r th success occurs at the x th trial. Substituting (11) into the definition of mgf

$$\begin{aligned} M_x(\theta) &= \sum_{R_x} e^{\theta x} p(r, x) \\ &= \frac{p^r}{q^r} \sum_{x=r}^{\infty} \binom{x-1}{r-1} (qe^{\theta})^x \end{aligned}$$

gives

$$M_x(\theta) = \frac{(pe^{\theta})^r}{(1-qe^{\theta})^r} \quad (12)$$

where it is assumed that $0 < qe^{\theta} < 1$.

The use of $\mu'_k = \left. \frac{d^k M_x(\theta)}{d\theta^k} \right|_{\theta=0}$ leads to

$$\mu'_1 = \frac{r}{p},$$

$$\mu'_2 = \frac{r(r+q)}{p^2},$$

$$\mu'_3 = \frac{r^3 + (3r^2+r)q + rq^2}{p^3},$$

and

$$\mu'_4 = \frac{r^4 + (r+4r^2+6r^3)q + (4r+7r^2)q^2 + rq^3}{p^4}. \quad (13)$$

Substitution of (13) into (3) yields

$$\mu_1 = \frac{r}{p},$$

$$\mu_2 = \frac{rq}{p^2},$$

$$\mu_3 = \frac{rq(1+q)}{p^3},$$

and

$$\mu_4 = \frac{rq[1+(4+3r)q+q^2]}{p^4}. \quad (14)$$

As a result the standardized third and fourth moments are

$$\alpha_3 = \frac{\mu_3}{\sigma^3} = \frac{1+q}{\sqrt{rq}} \quad (15)$$

and

$$\alpha_4 = \frac{\mu_4}{\sigma^4} = \frac{3rq+4q+1+q^2}{rq}. \quad (16)$$

Inserting α_3 and α_4 from (15) and (16) into inequalities (9), (10), respectively, gives

$$n_3 \geq \frac{(1+q)^2}{rq\epsilon_3} \quad (17)$$

and

$$n_4 \geq \frac{(1+q)^2 + 2q}{rq\epsilon_4}. \quad (18)$$

Therefore, the required number of variates to include in (4) for a satisfactory normal approximation is $n_{\min} = \max(n_3, n_4)$. Equations (17), (18) show that, for fixed values of r and q , the third moment is dominant in determining the value of n_{\min} ; for example, when $0 < \epsilon_3 = \epsilon_4 = \epsilon \leq 2/3$, $n_3rq\epsilon \geq (1+q)^2/\epsilon$ and $n_4rq\epsilon \geq (1+q)^2 + 2q$. Since $0 \leq q \leq 1$, $(1+q)^2/\epsilon \geq (1+q)^2 + 2q$ so that $n_3rq\epsilon \geq n_4rq\epsilon$ and hence $n_3 \geq n_4$.

Similar procedures are used for the other discrete RV's. Table 1 lists (a) the pdf, (b) the mgf, (c) moments $\mu_1, \mu_2, \mu_3, \mu_4$, (d) expressions for α_3, α_4, n_3 and n_4 for the other three discrete RV's studied.

Table 1. n_3, n_4 for some discrete random variables.

pdf	mgf	moments	$\alpha_i, n_i \ (i = 3, 4)$
Poisson dist. $p(x) = \frac{\lambda^x (e^{-\lambda})}{x!}$, where $x = 0, 1, \dots$	$\exp[\lambda(e^\theta - 1)]$	$\mu_1 = \lambda$	$\alpha_3 = \frac{1}{\lambda}$
		$\mu_2 = \lambda$	$\alpha_4 = \frac{1}{\lambda} + 3$
		$\mu_3 = \lambda$	$n_3 \geq \frac{1}{\lambda \epsilon_3^2}$
		$\mu_4 = 3\lambda^2 + \lambda$	$n_4 \geq \frac{1}{\lambda \epsilon_4}$
Geometric dist. $p(x) = pq^{x-1}$, where $x = 1, 2, 3, \dots$	$\frac{pe^\theta}{1 - qe^\theta}$	$\mu_1 = \frac{1}{p}$	$\alpha_3 = \frac{2-p}{\sqrt{1-p}}$
		$\mu_2 = \frac{q}{p^2}$	$\alpha_4 = \frac{p^2 - 9p + 9}{1-p}$
		$\mu_3 = \frac{(1-p)(2-p)}{p^3}$	$n_3 \geq \frac{(2-p)^2}{(1-p)\epsilon_3^2}$
		$\mu_4 = \frac{(1-p)(p^2 + 9q)}{p^4}$	$n_4 \geq \frac{p^2 - 6p + 6}{(1-p)\epsilon_4}$
Binomial Dist. $p(x) = \binom{k}{x} p^x q^{k-x}$ where $x = 0, 1, \dots, k$	$(pe^\theta + q)^k$	$\mu_1 = kp$	$\alpha_3 = \frac{1-2p}{\sqrt{kp(1-p)}}$
		$\mu_2 = kp(1-p)$	$\alpha_4 = \frac{(3p^2 - 3p)(2-k) + 1}{kp(1-p)}$
		$\mu_3 = kp(1-p)(1-2p)$	$n_3 \geq \frac{(1-2p)^2}{kp(1-p)\epsilon_3^2}$
		$\mu_4 = kp(1-p)[(3p^2 - 3p)(2-k) + 1]$	$n_4 \geq \frac{6p^2 - 6p + 1}{kp(1-p)\epsilon_4}$

Normal Approximation of Simple Linear Combinations

The Binomial Distribution

The binomial RV is essentially a SLC of the RV involved in a Bernoulli process, and normal approximation of such a SLC has been extensively discussed in [3] and will not be repeated here. In general, however, moderate departures of the fourth moment from 3 do not as seriously affect the normal approximation as does that of the third moment from zero. This is consistent with the well-known empirical rule that the binomial distribution should be approximated by the normal only if p , the pr. of success in each trial, lies within the range (.10, .90), outside of which the departure of the third moment from zero is not moderate.

The Poisson Distribution

Express n_3 and n_4 indicate that the third moment, α_3 , for the Poisson distribution usually will dominate in determining n_{\min} . In particular, $n_3 > n_4$ whenever $\epsilon_3 < \sqrt{\epsilon_4}$. A satisfactory normal approximation of a SLC of Poisson RV's is therefore much more sensitive to any asymmetry of the Poisson rather than being sensitive to departures from the mesokurtic condition. For the case $\epsilon_3 = \epsilon_4$, $n_{\min} = n_3$ for any λ . In general, n_{\min} is a decreasing function of λ for any ϵ_3, ϵ_4 .

The Geometric Distribution

Since the geometric distribution is a special case of the negative binomial (with $r = 1$), it follows that the third moment is dominant in determining the value of n_{\min} . For any skewed distribution, $n_{\min} = n_3$ unless $\epsilon_4 \ll \epsilon_3$. When $\epsilon_3 = \epsilon_4$ then $n_{\min} = n_3$, and for $0 < p < .7$ the value of n_{\min} is relatively constant (although an increasing function of p). For $p > .7$ when $\epsilon_3 = \epsilon_4$, n_{\min} increases rapidly with increasing values of p .

ANALYSES OF CONTINUOUS DISTRIBUTIONS

Five continuous random variables are examined, viz. the gamma, uniform, exponential, beta, and triangular. The analytical method is shown in some detail for the gamma distribution, and results for the other cases are summarized in Table 2 and discussed separately.

The Gamma Distribution

The gamma pdf is

$$f(x) = \frac{1}{a^b \Gamma(b)} x^{b-1} e^{-x/a}, \quad x, a, b > 0$$

where Γ denotes the well-known gamma function.

Table 2. n_3, n_4 for some continuous random variables.

pdf	mgf	moments	$\alpha_i, n_i \ (i = 3, 4)$
Uniform dist. $\begin{cases} \frac{1}{b-a}, & 0 \leq x \leq b \\ 0, & \text{elsewhere} \end{cases}$	$\frac{e^{\theta b} - e^{\theta a}}{(b-a)\theta}$	$\mu_1 = \frac{b+a}{2}$ $\mu_2 = \frac{(b-a)^2}{12}$ $\mu_3 = 0$ $\mu_4 = \frac{(b-a)^4}{80}$	$\alpha_3 = 0$ $\alpha_4 = 1.8$ $n_3 = 0$ $n_4 \geq \frac{1.2}{\epsilon_4}$
Exponential dist. $\begin{cases} \frac{1}{b} e^{-x/b}, & x > 0 \\ 0, & \text{elsewhere} \end{cases}$	$(1-b\theta)^{-1}$	$\mu_1 = b$ $\mu_2 = b^2$ $\mu_3 = 2b^3$ $\mu_4 = 9b^4$	$\alpha_3 = 2$ $\alpha_4 = 9$ $n_3 \geq \frac{4}{\epsilon_3}$ $n_4 \geq \frac{6}{\epsilon_4}$
Beta dist. $\begin{cases} \frac{\Gamma(a+b)}{\Gamma(a)\Gamma(b)} x^{a-1}(1-x)^{b-1}, & 0 < x < 1, a > 0, b > 0 \\ 0, & \text{elsewhere} \end{cases}$	$\frac{\Gamma(a+b)}{\Gamma(a)} \cdot \sum_{k=0}^{\infty} \frac{\theta^k \Gamma(a+k)}{k! \Gamma(a+b+k)}$	$\mu_1 = \frac{a}{a+b}$ $\mu_2 = \frac{ab}{(a+b)^2(a+b+1)}$ $\mu_3 = \frac{2ab(b-a)}{(a+b)^3(a+b+1)(a+b+2)}$ $\mu_4 = \frac{3ab(a^2b+ab^2+2a^2+2b^2-2ab)}{(a+b)^4(a+b+1)(a+b+2)(a+b+3)}$	$\alpha_3 = \frac{2(b-a)}{(a+b+2) \sqrt{\frac{ab}{a+b+1}}}$ $\alpha_4 = \frac{3(a+b+1)(a^2b+ab^2+2a^2+2b^2-2ab)}{ab(a+b+2)(a+b+3)}$ $n_3 \geq \frac{4(b-a)^2(a+b+1)}{(a+b+2)^2 ab \epsilon_3}$ $n_4 \geq \frac{6a(a+1)(a-2b)+6b(b+1)(b-2a)}{ab(a+b+2)(a+b+3) \epsilon_4}$

Table 2---continued

pdf	mgf	moments	$\alpha_i, n_i \ (i = 3, 4)$
Symmetrical triangular dist. $\begin{cases} \frac{x+a}{a^2}, & -a \leq x \leq 0 \\ \frac{a-x}{a^2}, & 0 \leq x \leq a \\ 0, & \text{elsewhere} \end{cases}$	$\frac{e^{a\theta} + e^{-a\theta} - 2}{a^2 \theta^2}$	$\begin{aligned} \mu_1 &= 0 \\ \mu_2 &= \frac{a^2}{6} \\ \mu_3 &= 0 \\ \mu_4 &= \frac{a^4}{15} \end{aligned}$	$\begin{aligned} \alpha_3 &= 0 \\ \alpha_4 &= 2.4 \\ n_3 &= 0 \\ n_4 &\geq \frac{.6}{\epsilon_4} \end{aligned}$
Asymmetrical triangular dist. $\begin{cases} \frac{2(x+a)}{a(a+b)}, & -a \leq x \leq 0 \\ \frac{2(b-x)}{b(a+b)}, & a, b > 0 \\ 0, & \text{elsewhere} \end{cases}$	$2 \frac{\left(\frac{e^{-a\theta} - 1}{a} + \frac{e^{b\theta} - 1}{b} \right)}{(a+b)\theta^2}$	$\begin{aligned} \mu_1 &= \frac{b-a}{3} \\ \mu_2 &= \frac{a^2 + ab + b^2}{18} \\ \mu_3 &= \frac{2b^3 + 3b^2a - 3ba^2 - 2a^3}{270} \\ \mu_4 &= \frac{a^4 + 2a^3b + 3a^2b^2 + 2ab^3 + b^4}{135} \end{aligned}$	$\begin{aligned} \alpha_3 &= \frac{\sqrt{2}(2b^3 + 3b^2a - 3ba^2 - 2a^3)}{5(\sqrt{a^2 + ab + b^2})^3} \\ \alpha_4 &= 2.4 \\ n_3 &\geq \frac{2(2b^3 + 3b^2a - 3ba^2 - 2a^3)^2}{25(a^2 + ab + b^2)^3 \epsilon_3^2} \\ n_4 &\geq \frac{.6}{\epsilon_4} \end{aligned}$
Right triangular dist. (I) $\begin{cases} \frac{2(a-x)}{a^2}, & 0 < x < a \\ 0, & \text{elsewhere} \end{cases}$	$\frac{2(e^{a\theta} - a\theta - 1)}{a^2 \theta^2}$	$\begin{aligned} \mu_1 &= \frac{a}{3} \\ \mu_2 &= \frac{a^2}{18} \\ \mu_3 &= \frac{a^3}{135} \\ \mu_4 &= \frac{a^4}{135} \end{aligned}$	$\begin{aligned} \alpha_3 &= .5657 \\ \alpha_4 &= 2.4 \\ n_3 &\geq \frac{.32}{\epsilon_3^2} \\ n_4 &\geq \frac{.6}{\epsilon_4} \end{aligned}$

Table 2--continued

pdf	mgf	moments	$\alpha_i, n_i \ (i = 3, 4)$
Right triangular dist. (II) $\begin{cases} \frac{2(a+x)}{a^2}, & -a < x < 0 \\ 0, & \text{elsewhere} \end{cases}$	$\frac{2(e^{-a\theta} + a\theta - 1)}{a^2 \theta^2}$	$\mu_1 = -\frac{a}{3}$	$\alpha_3 = -.5657$
		$\mu_2 = \frac{a^2}{18}$	$\alpha_4 = 2.4$
		$\mu_3 = -\frac{a^3}{135}$	$n_3 > \frac{.32}{\epsilon_3}$
		$\mu_4 = \frac{a^4}{135}$	$n_4 > \frac{.6}{\epsilon_4}$

* The dot indicates multiplication.

Normal Approximation of Simple Linear Combinations

The mgf is

$$M_X(\theta) = \int_0^{\infty} \frac{1}{a^b \Gamma(b)} x^{b-1} e^{-x(1/a-\theta)} dx$$

where $1/a > \theta$ and the transformation $u = (\frac{1}{a} - \theta)x$ and the fact that

$\Gamma(b) = \int_0^{\infty} u^{b-1} e^{-u} du$ reduces the integral on the right to

$$M_X(\theta) = (1 - a\theta)^{-b} . \quad (19)$$

The first four derivatives of (19) evaluated at $\theta = 0$ lead to

$$\begin{aligned} \mu_1' &= ab \\ \mu_2' &= a^2 b(b+1) \\ \mu_3' &= a^3 b(b+1)(b+2) \\ \mu_4' &= a^4 b(b+1)(b+2)(b+3) . \end{aligned} \quad (20)$$

Combining (20) with (3) yields

$$\begin{aligned} \mu_1 &= ab , \\ \mu_2 &= a^2 b , \\ \mu_3 &= 2a^3 b \end{aligned}$$

and

$$\mu_4 = 3a^4 b(b+2) .$$

Consequently, the standardized third and fourth moments are

$$\alpha_3 = \frac{\mu_3}{\sigma^3} = \frac{2}{\sqrt{b}} \quad (21)$$

and

$$\alpha_4 = \frac{\mu_4}{\sigma^4} = \frac{3(b+2)}{b} . \quad (22)$$

Inserting α_3 and α_4 from (21) and (22) into inequalities (9), (10), respectively, gives

$$n_3 \geq \frac{4}{b \in 3} \quad (23)$$

and

$$n_4 \geq \frac{6}{b\epsilon_4} . \quad (24)$$

Examination of the last two equations reveals that because of skewness of the distribution, the third moment is dominant in determining the value of n_{\min} . For example, through simple algebra, it can be shown that $n_3 \geq n_4$ for $0 < \epsilon_3 = \epsilon_4 \leq 2/3$, and unless $\epsilon_4 < 1.5\epsilon_3^2$, $n_{\min} = n_3$.

Similar procedures are used for the other continuous RV's. Table 2 lists (a) the pdf, (b) the mgf, (c) moments $\mu_1, \mu_2, \mu_3, \mu_4$, (d) expressions for α_3, α_4, n_3 and n_4 .

The Uniform Distribution

Since this distribution is symmetrical, $n_{\min} = n_4$, and $n_4 \geq 1.2/\epsilon_4$. For example, if $\epsilon_4 = .15$, then $n = 8$, implying that an 8-fold convolution of a uniform distribution over (a, b) has identical first three moments as those of a normal density with mean $(b + a)/2$, variance $(b - a)^2/12$, and its standardized fourth moment, $\alpha_4(Sg)$, is within .15 of the corresponding normal density.

The Exponential Distribution

The exponential is a special case of the gamma distribution for which $b = 1$, and the values of $\alpha_3 = 2, \alpha_4 = 9$ indicate that it is positively skewed and leptokurtic. For $\epsilon_3 = \epsilon_4$, $n_{\min} = n_3 \geq 4/\epsilon_3^2$ and, in general, $n_{\min} = n_3$ whenever $\epsilon_3^2/\epsilon_4 \leq 2/3$.

The Beta Distribution

Since the third and fourth moments of the beta distribution are complicated expressions of the parameters a and b , the following cases are considered separately.

The case of $a = b$. When $a = b$, then $\alpha_3 = 0$, and $\alpha_4 = \frac{3(2b+1)}{2b+3} < 3$ implies the distribution is platykurtic. Therefore, ϵ_3 can be chosen arbitrarily close to zero and (10) shows $n_{\min} = n_4 \geq \frac{6}{[2b+3]\epsilon_4}$. As b increases in value, α_4 approaches 3 from below and the beta distribution approaches a normal density with mean $1/2$ and variance $1/[4(2b+1)]$.

The case of $a > b$. In this instance, the beta distribution is negatively skewed ($\alpha_3 < 0$). It is leptokurtic when $b > 1$ and $a > 2.85578b$, or when $2.618b < a < 2.856b$ and b is sufficiently large. It is platykurtic when $0 < b < 1$ and $a < 2.85578b$, or when $b < a \leq 2.618b$. Due to the skewness of the distribution, $n_{\min} = n_3$ unless $b < \bar{a} < 1.3b$ in which case the distribution has little skewness and $n_{\min} = n_4$ for all ϵ_3 and ϵ_4 .

Normal Approximation of Simple Linear Combinations

The case of $a < b$. For $a < b$, the beta distribution is positively skewed ($\alpha_3 > 0$). It is leptokurtic when $2.85578a < b$ and $a > 1$, or when $2.618a < b < 2.856a$ and a is sufficiently large. When $a < b < 2.618a$, or $a < 2.85578b$ with $0 < b < 1$, the distribution is platykurtic. Unless the values of a and b are fairly close, say $a < b < 1.3a$, in which case there is little skewness, the value of n_{\min} should be based solely on the magnitude of α_3 , i.e., $n_{\min} = n_3$. When a and b are not far apart, $n^* = n_4$ unless $\epsilon_3 \ll \epsilon_4$.

The Triangular Distribution

When the triangular distribution is symmetrical, n_{\min} is determined by the fourth moment, and the right column of Table 2 shows $n_{\min} \geq .6/\epsilon_4$. Since the right triangular distribution is skewed, the third moment determines n_{\min} unless $\epsilon_4 < 1.875\epsilon_3^2$. The asymmetrical triangular distribution is always platykurtic. It may be positively or negatively skewed according to $b > a$ or $b < a$, respectively. Assuming $\epsilon_3 = \epsilon_4$, then $n_{\min} = n_3$ under the condition $b < .6945a$ or $b > 1.439a$. When $.6945a < b < 1.439a$, the fourth moment dominates and $n_{\min} = n_4$ unless $\epsilon_3 \ll \epsilon_4$. For example, when $.6945a < b < 1.439a$ and $\epsilon_3 = \epsilon_4 = .05$, $n_{\min} = n_4 = 12$.

SUMMARY AND CONCLUSIONS

1. Generally, if the distribution of X_i , $i = 1, 2, \dots, n$, is asymmetrical, the magnitude of departure of α_3 from zero essentially determines n_{\min} .
2. If the distribution of X_i 's is symmetrical, then $\alpha_3 = 0$ and only the magnitude of departure of α_4 from 3 determines the adequacy of the normal approximation.
3. If the distribution of X_i is not highly skewed (i.e., α_3 is much closer to zero than α_4 is to the value of 3), then the fourth moment becomes dominant in determining n_{\min} provided ϵ_4 is specified sufficiently small relative to ϵ_3 .
4. Finally, the subject of how small ϵ_3 , ϵ_4 should be so that the normal distribution has approximately the same quantiles as those of the exact (but unknown) distribution of S_n , is an area of research currently being investigated.

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FIRST RECORD OF THE PINK WORMFISH (*Microdesmus longipinnis*)
IN ALABAMA WATERS¹

Edward Rosa-Molinar and Stephen B. Ruth

Department of Biology
Carver Research Laboratories
Tuskegee Institute, AL 36088

A new distributional record of the pink wormfish *Microdesmus longipinnis* (Weymouth) has been found in Alabama waters. The range of *M. longipinnis* includes Bermuda and the coast of Georgia westward to Cedar Bayou, Texas (Dawson, 1969). However, its presence off Alabama so far only has been assumed.

In sampling the Mobile Bay area on April 21, 1979 we collected a single specimen 6.4 km south of Dauphin Island, AL, trawled at a depth of 6.4 m. It is presently deposited in the Auburn University fish collection (catalog number 19665).

We asked curators at several ichthyological museums to check their holdings for other pink wormfish records in Alabama. Dr. R. L. Shipp located 5 specimens from a single sample deposited at the University of South Alabama collection of fishes (catalog number 06439) captured in Mobile Bay 200 yards north of Fly Creek mouth, Baldwin County, AL, on August 8, 1978.

The standard length of our specimen is 196 mm. The standard lengths of the Mobile Bay fish range from 200 to 232 mm. Counts and measurements on all specimens fell within limits determined by Dawson (1962).

Extensive sampling of the northern Gulf of Mexico and the Mobile Bay area is needed to determine the distribution and occurrence of *M. longipinnis*.

We thank D. Nestor and R. Shipp for the loan of the additional specimens and H. T. Boschung and J. S. Ramsey for their helpful suggestions.

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ABSTRACT

TALLADEGA SLATE BELT STRATIGRAPHY IN COOSA COUNTY, ALABAMA

William S. Pendexter. Dept. of Geology, The University of Alabama.

A major carbonate sequence occurs in the lower part of the Talladega slate belt in Chilton, Coosa and Talladega Counties. The carbonate units are overlain by a regional unconformity known as the pre-Lay Dam Formation unconformity. The carbonate sequence below the unconformity is represented in different areas by the Jumbo Dolomite, the Marble Valley carbonates, and the Sylacauga marbles. At the type location in Chilton County the Jumbo is a 67' m thick, predominantly thickly bedded dolostone. The contact with the underlying slates of the Wash Creek Slate (Mt. Zion Fm.) is an interlayered zone of dolostone and fine, commonly graphitic, clastic rock. This zone grades upward into a dolostone that contains few pelitic layers. Near the base, the Jumbo contains intraclasts of laminated and massive carbonate up to 12 cm in length. The intraclasts are in layers in the lower 15 m of dolostone. Rounded quartz grains are disseminated in the lower section of the dolostone. Just below the unconformity at the type section, the Jumbo contains laminations of fine-grained clastic rock. Along strike the unconformity appears to have erosional relief. Less than 2 km west of the type location the unconformity cuts the Jumbo Dolomite completely. To the northeast the unconformity appears to rise in the section in the Marble Valley carbonates and the Sylacauga marbles, exposing a very thick carbonate sequence. Stratigraphic and structural relationships of the Jumbo, Marble Valley, and Sylacauga marbles are not yet resolved. Initial data indicate that the Jumbo occurs stratigraphically below and to the northwest of the Marble Valley carbonates suggesting that the Jumbo is the oldest carbonate unit in the sequence.

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R. T. Gudauskas, Chairman, Department of Botany, Plant Pathology, and Microbiology, Auburn University, AL 36849

J. F. Pritchett, Department of Zoology-Entomology, Auburn University, AL 36849

J. M. Beaton, Department of Neuroscience, University of Alabama in Birmingham, University Station, Birmingham, AL 35294

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MESSAGE FROM THE PRESIDENT

Charles M. Baugh
College of Medicine
University of South Alabama
1005 Medical Sciences Building
Mobile, AL 36688

Scholarly journals have become standard communicative devices for learned societies. However, the quality and interest generated by one issue may impact, not only upon the circulation of subsequent issues, but also upon the submission, by prospective authors, of manuscripts for future issues. When circulation falls or manuscripts become scarce, the usual remedy applied by editorial boards is to become more quality conscious, to review and reject more vigorously and to generally further decimate the ever shrinking pool of submitted manuscripts. Next an issue or two is missed because of lack of material and circulation declines further. A now classic death struggle for the journal ensues. Authors will not submit manuscripts because circulation is down and circulation drops precipitously due to the quality and, at this stage, quantity of manuscripts submitted.

The *Journal of the Alabama Academy of Science* is presently enmeshed in the scenario described above. How can this be possible for a journal that has survived for fifty-three years? Why should this journal be in difficulty when new journals are constantly emerging as successful economic ventures, even in the most narrow and esoteric specialties? The answers to these questions are complex. The triggering device which began the decay process is not easy to identify with certainty. Yet, its identification is crucial if we are to institute appropriate remedies. A speculated candidate trigger that has floated around the Academy for several years centers around the attitude of some academic administrators in higher education across the state toward the Journal. These administrators, it is said, do not recognize the legitimacy of publications in the *Journal of the Alabama Academy of Science* in making promotion and tenure considerations for their faculties. This position is puzzling in view of the facts: 1) that manuscripts submitted for publication in the *Journal of the Alabama Academy of Science* are peer reviewed by at least two reviewers and, in cases of conflicting reviews, a third reviewer is used; 2) that approximately 50% of the manuscripts submitted are rejected on the basis of scientific merit; and 3) that the Journal is abstracted by both Chemical Abstracts and Biological Abstracts. Even more puzzling is the fact that some of these same administrators have been known to recognize "letters to the editor" and even privately published materials as legitimate scholarly contributions. Whatever

Message from the President

the underlying causes may be which have created our present dilemma with the Journal, it is important that we pick up the gauntlet and engage in a concerted effort to preserve this important part of the Academy.

What can we do? What needs to be done? How do we begin? In discussing the Journal problems with the Editor and other members of the Executive Committee, two ideas have emerged as attractive potential solutions to these problems.

The first involves adding major invited reviews by authoritative Academy members as a regular feature of the Journal. This action has the potential for greatly enhancing the Journal's national image and, if the quality were maintained over a protracted period, to increase circulation. It would be critical that the topics reviewed and the reviewers be selected with great care, and that reprints of the review be widely circulated.

A second proposal that has been discussed with a great deal of enthusiasm involves a consolidation of the *Journal of the Alabama Academy of Science* with the publications of academies from the surrounding southeastern United States. Such action would provide an instant and very significant increase in circulation for all the academy publications. One could envision a broad based *Proceedings of the Southeastern Academies of Science* that would be similar in format and subject matter to the *Proceedings of the National Academy of Science*.

Inspection of the table on the opposite page will show that such a coalition of southeastern academies would provide a circulation in excess of 6,500 when libraries are added. This number would merit publication assistance by commercial firms. We are in a period when such specialized Journals as the *Neurobiology of Aging*, *Peptides*, and *The Cyclic Nucleotides* add to the literature explosion, while constantly focusing the scientist more and more narrowly in his reading. Perhaps a consolidated publication such as *The Proceedings of the Southeastern Academies of Science*, in its coverage of a wide range of topics and its major reviews, would be a welcome change in direction. Furthermore, the potential exists to replace nine relatively weak publications with a single strong one.

The officers of the Academy are currently exploring these ideas and avenues to solve the Journal's problems. As a member of the Academy, your input is of great interest and importance. It is unthinkable that a major change in direction, such as just described, would be undertaken without strong support and encouragement from the Academy members and the Board of Trustees. Please take a few minutes to express your ideas and attitudes on these critical matters.

TABLE 1. Membership and Journal Data on Southeastern Academies of Science

<u>ACADEMY</u>	<u>PUBLICATION</u>	<u>MEMBERSHIP 1981-82</u>
Alabama	Yes	725
Arkansas	Yes	250
Florida	Yes	625
Georgia	Yes	572
Louisiana	Yes	800
Mississippi	Yes	936
New Orleans	No	150
North Carolina	Yes	1200
South Carolina	Yes	568
Tennessee	Yes	700
<hr/>	<hr/>	<hr/>
Totals: 10	9 Yes	5801

ANNOUNCEMENT OF APPOINTMENT OF AN ADMINISTRATIVE OFFICER

In a move culminating several years of discussion and deliberation, the Executive Committee on March 18, 1982, appointed Dr. William J. Barrett to the new post of Administrative Officer. The creation of this part-time, paid position resulted, in part, from recognition of a need to improve the prestige of the Academy and to make its capabilities more widely known to the scientific and lay communities. Another important consideration was a need to provide a continuing level of overall coordination of Academy activities.

The principal duties of the new officer, who is to work under the direction of the Steering Committee, were defined as follows:

Develop improved public relations, primarily inside Alabama but extending to interaction with national organizations;

Strengthen membership activities;

Raise funds for support of the Academy and the Junior Academy;

Improve acceptance of the Journal;

Arrange the program for the annual meeting.

Until his recent retirement, Dr. Barrett was Director of Research in Applied Sciences at Southern Research Institute. For the present, he will maintain an office at his home, 94 Lucerne Boulevard, Birmingham, AL 35209 (telephone 205-879-3098). He invites comments and suggestions from the membership.

Nest Characteristics of a Yellow-Crowned Night
Heron (*Nyctanassa violacea*) Colony¹

Daniel J. Drennen, Laura Jean Hunt, and Tommy King
Department of Zoology-Entomology
Auburn University

INTRODUCTION

No significant nest characteristics of Yellow-Crowned Night Herons (*Nyctanassa violacea*) have been documented in the literature. For this reason we are reporting on a colony located at Spring Creek, Alabama (4.5 miles southwest of Cottonwood, Alabama, T7N, R27E, SE 1/4 Sec. 17; 31°05' latitude, 85°25' longitude).

The section of the creek inhabited by the herons is approximately 2400 m long. The area is thickly vegetated with oaks (*Quercus* sp.), red ash (*Fraxinus pennsylvanica*), tupelo gum (*Nyssa aquatica*), swamp dogwood (*Cornus stricta*), cedar (*Juniperus* sp.), and numerous shrubs, many of which overhang the creek and support the heron nests. In the literature, Johnstone (1962) reported vegetation used by Yellow-Crowned Night Herons on the Dog River, near Mobile, consisting of huge trees such as pines, magnolias, maples and blackgums. The nests we studied varied in size and were constructed of interwoven twigs and small branches. Additional birds seen feeding in the area included passerines, Little Blue Herons (*Florida caerulea*), and White Ibises (*Eudocimus albus*).

MATERIALS AND METHODS

The heron colony was visited twice after the initial discovery. On 24 May 1980 the number of nests and nestlings were determined by direct count. The nestling's age and general feather condition were noted according to Palmer (1962).

In order to capture a nestling, two canoes were positioned under a nest. A 1 m long hook was attached to a 4 m long cane pole (Dusi 1967) and was extended upward to the nest and placed around the nestling's neck. A shallow wire basket attached to an additional cane pole was then extended toward the nest. The hooked pole was pulled gently but firmly, outward and slightly upward. The nestling was led out of the nest and onto the basket. The hook was removed and the basket was carefully lowered into the canoe. The heron was banded and returned by raising it in the basket and allowing it to step back into the nest.

¹Manuscript received 11 July 1981; accepted 14 December 1981.

Yellow-Crowned Night Heron

Physical data collected during the 16 June 1980 trip included: (1) nest height above water surface, (2) depth of water below nest, (3) Diameter at breast height (DBH) and species of tree supporting nest, and (4) distance between nests. Nest height and water depths were measured from the canoe by using a tape measure that was attached to a cane pole. Distances between nests were measured by planting the end of the cane pole into the creek bottom below a nest and attaching a tape measure to the pole. The tape measure was let out as the canoe was slowly paddled to the next nest.

RESULTS AND DISCUSSION

The nests consisted of various size twigs that were attached to a supporting limb over the water. Contrary to the findings of Bent (1926), Harrison (1975), and Imhof (1976), there was no evidence of finer materials lining the nests. A total of 25 nestlings were observed. Table 1 contains the physical and biological data. The number per nest ranged from 1 to 4 with an average of 2.5 per nest. Six of the 17 nests contained no eggs or young. Twelve of the 25 nestlings were successfully caught and banded with Fish and Wildlife Service aluminum leg bands. The approximate age of the nestlings varied from 2 to 5 weeks with the majority in the 5-week stage. All banded nestlings appeared to be healthy. Data for six nests found destroyed on 21 July 1980 are not presented in Table 1. On 24 May 1980 there had been a total of 9 nestlings (0-3 per nest) at approximate ages of 3 or 5 weeks old. Seven of these birds were banded (1187-70106 through 1187-70112).

The horizontal distance between nests ranged from 4.9 to 92.1 m with an average of 24.2 m. Harrison (1975) reported distances of 3.7 to 7.6 m. As expected, there was never more than one nest per tree (Bent 1926).

The height of the nests above the water surface ranged from 2.6 to 11.9 m, with an average of 2.3 m. In other published data Bent (1926) reported heights of 12.1 to 21.3 m, Harrison (1975) reported heights of 0.3 to 15.2 m and McVaugh (1975) reported heights of 2.1 to 4.3 m.

Although there was considerable variation in nest heights, the nests were always built on the limb closest to the water which could support them. Bent (1926) has suggested that the nests may be built in this position to give eggs and nestlings the benefit of the shade of the upper branches. On the day that these measurements were taken, the water depth below the nests ranged from 0.8 to 1.2 m.

Because of the limited accessibility, the dimensions of only one nest could be measured. The outside diameter was 1.25 m, the inner diameter was 0.63 m and the depth was 0.06 m. Harrison (1975) reported the outside diameter as 0.51 m and Bent (1926) described a nest in Florida as "20 by 16 inches," (0.51 m by 0.1 m). Palmer (1962) stated that sticks may be added to the nest after young hatch.

This may be the reason for the apparent large outer diameter of the nest. Yellow-Crowned nests may be built similarly to Black-Crowned Night Heron (*Nycticorax nycticorax*) nests (Dusi 1966).

Trees supporting the nests (Table 1) were mainly red ash and tupelo gum. Nests were found less frequently in smooth blackhaw (*Viburnum prunifolium*), oak and swamp dogwood. The DBH ranged from 0.32 to 2.2 m.

Dusi (1966) described the behavior of the birds as "slow and stupid", while Plamer (1962) noted that when disturbed by man there were "no distraction displays, but adults tended to remain quietly near the nest..." The adults in our study were observed at times to call and fly overhead. Audubon (cited in Palmer 1962) found that many adults seemed to circle around to watch an intruder at the nest. Johnstone (1965) reported that sudden noises frightened birds from the trees. When we disturbed the nestlings many defecated or regurgitated food. This may have been a displacement activity resulting from high-intensity motivation (Van Tyne 1976) and/or a defense mechanism. When the regurgitated food was analyzed in the field it consisted mainly of crayfish parts. Similar to what Palmer (1962) described, some of the inner surfaces of the nests were stained pink from the excreta of young fed crayfish.

CONCLUSION

The physical nesting and behavioral characteristics of the Yellow Crowned Night Heron were reported. The herons constructed one nest per tree with distances between the nests ranging from 5 to 24 m. In some cases the distances were greater than 50 to 90 m. The significance of these measurements were not clear. On the one hand, a "loose colony" of herons that does not concentrate their activities within a specific area are less likely to be noticed by predators. On the other hand, individuals of a "loose colony" that covers a large amount of stream bank (2400 m in our case), may not be able to communicate readily with each other about possible dangers.

The significance of nest height, depth of water, and DBH of nest tree were also difficult to assess. They are determined by such environmental variables as microclimate, storm damage, flooding, density of foliage, nutrition, predation, and others. Many similar studies have shown variable and conflicting results (Welty 1975).

ACKNOWLEDGEMENTS

The authors would like to thank the following people for their assistance: Dr. J. L. Dusi and Dr. J. D. Freeman of Auburn University, James A. Seay and D. C. Neel.

Yellow-Crowned Night Heron

Table 1. NEST DATA

Nest	Distance between nests (m)	Distance above water(m)	Depth of water (m)	DBH (m)	Supporting tree	Number ^a of Nestlings	Approx. ^a Age (weeks)	Band ^{a,b} Number
1		11.9	0.9	2.2	Red Ash	0	--	--
2	5.5	5.6	1.0	0.8	Tupelo Gum	0	--	--
3	21.3	4.8	0.9	0.5	Red Ash	0	--	--
4	20.2	2.5	1.1	0.5	Smooth Blackhaw	2	5	101,102
5	53.3	3.9	0.9	0.8	Oak	0	--	--
6	92.1	2.5	0.8	0.3	Swamp Dogwood	0	--	--
7	9.7	5.3	0.8	0.5	Tupelo Gum	0	--	--
8	10.9	5.7	1.1	0.9	Red Ash	1	2	--
9	4.9	4.4	0.8	0.7	Red Ash	4	4	103,104
10	9.4	5.9	0.8	0.5	Red Ash	2	4	--
11	23.8	5.3	0.8	0.5	Tupelo Gum	4	5	105

a. Data taken 5-24-80

b. Only the last 3 numerals are listed. Band numbers were 1187-70101 through 1187-70105.

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REASSESSMENT OF THE DISTRIBUTION OF THREE AMPHIBIANS IN ALABAMA¹

Mark S. Davis and Thomas R. Jones
Department of Zoology-Entomology
School of Agriculture and Biological Sciences
and
Agricultural Experiment Station
Auburn University, Alabama 36849

Since the publication of *The Reptiles and Amphibians of Alabama* by Mount (1975), little information has been published concerning the distribution of Alabama amphibians. Redmond and Mount (1975) discussed the distribution of amphibians in the Coosa Valley; Hanlin et al. (1978) reported *Hyla cinerea* (Schneider) from Tallapoosa County; Jones (1979) reported new county records for *Ambystoma cingulatum* (Cope) and *Siren lacertina* Linnaeus in southeastern Alabama; and Moler (1982) reported *Hyla andersoni* Baird from portions of the Lower Coastal Plain. While conducting fieldwork in eastern-central Alabama during 1978-79, new localities for three amphibians, *Rana palustris* LeConte, *R. sylvatica* LeConte, and *Gyrinophilus porphyriticus* (Green) were discovered. These represent range extensions into a physiographic province previously thought to be uninhabited in Alabama by two of the three species.²

According to Mount (1975), the pickerel frog, *R. palustris*, occurs in Alabama locally "north of the Fall Line, except in the lower Piedmont and lower reaches of the Ridge and Valley region where it is apparently absent", as well as in portions of the Coastal Plain. We collected specimens in Randolph and Tallapoosa counties, extending the known range of this species further south into the Piedmont (Fig. 1). One locality in Tallapoosa County, south of the Tallapoosa River, extends the known range of *R. palustris* 52 km south of the previously known upper Piedmont sites.

Wood frogs, *R. sylvatica*, were discovered in Alabama in 1974 and reported by Mount (1975). At that time, wood frogs were thought to be restricted to the Blue Ridge physiographic province since they had been collected only on Mt. Cheaha in Cleburne County. Subsequent to 1975, several specimens were collected in the Piedmont at several locations in Clay, Cleburne, Randolph and Tallapoosa counties (Davis 1980) (Fig. 2). The southernmost of these sites extends the known

¹Manuscript received 11 December 1981; accepted 6 January 1982

²The term physiographic province as used here coincides with the herpetofaunal regions of Mount (1975), which agrees closely with the forest regions of Harper (1943) and the physiographic subdivisions of Fenneman (1938).

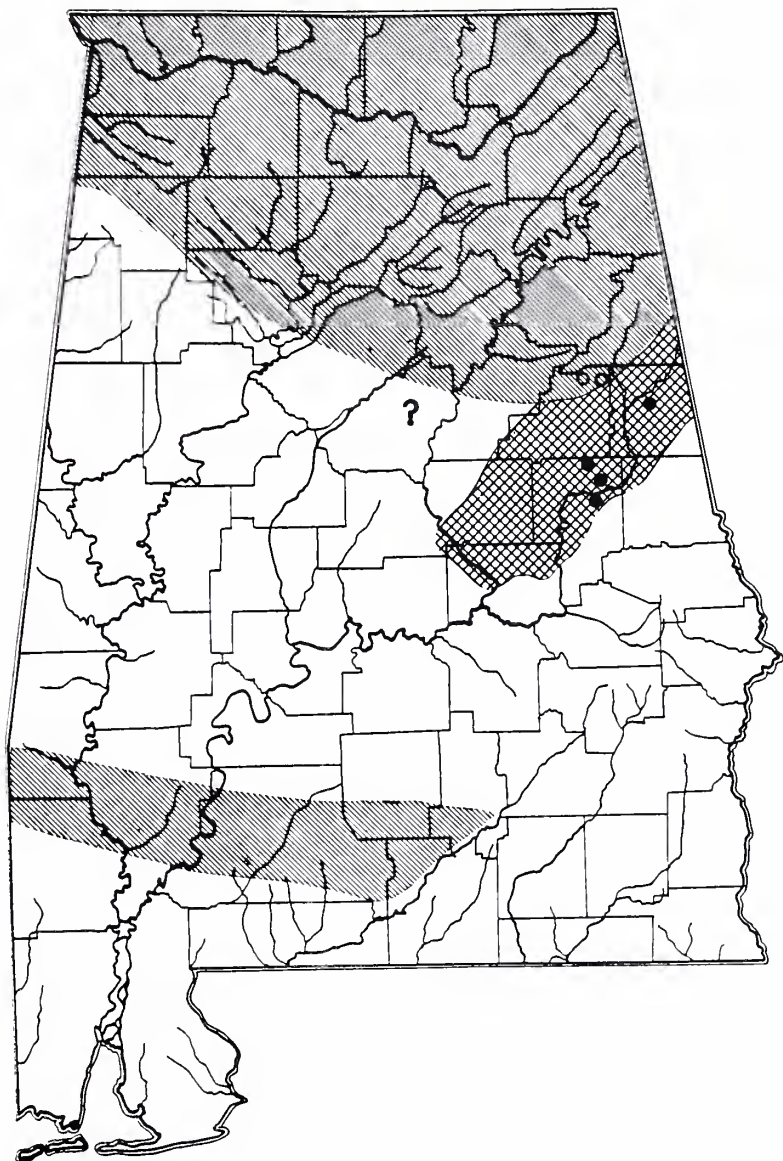


Figure 1. The distribution of *Rana palustris* in Alabama. Diagonal hatching indicates the range of the species in Alabama according to Mount (1975). Cross hatching indicates an addition to the presumed range of the species based on the present study. The solid circles represent localities from which specimens have been collected. The open circles represent the nearest previously known localities. The question mark indicates an area that may contain populations of *R. palustris*, but documentation is lacking.

Three Amphibians in Alabama

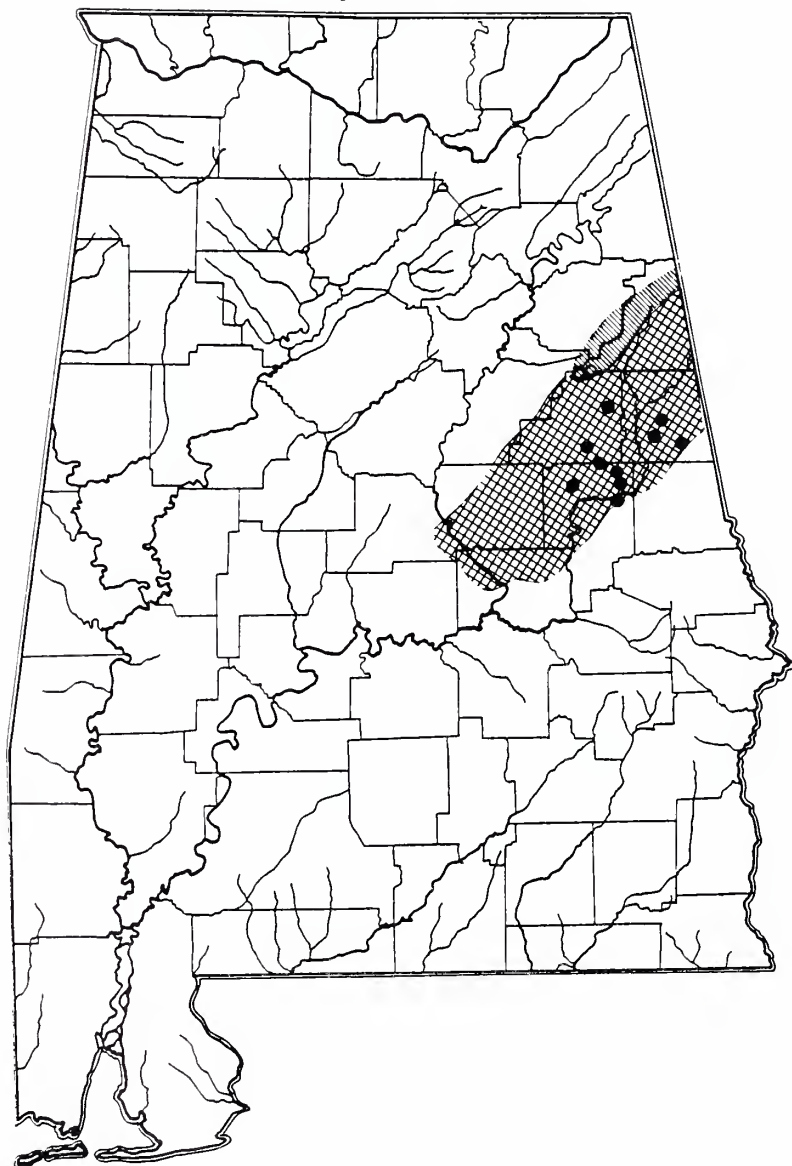


Figure 2. The distribution of *Rana sylvatica* in Alabama. Diagonal hatching indicates the range of the species in Alabama according to Mount (1975). Cross hatching indicates an addition to the presumed range of the species based on the present study. The solid circles represent localities from which specimens have been collected. The open circles represent the nearest previously known localities.

range of *R. sylvatica* 57 km south of the Mt. Cheaha localities. Additional localities in the Blue Ridge have also been found north-east of Mt. Cheaha.

The distribution of the spring salamander, *Gyrinophilus porphyriticus*, in Alabama was thought to be limited to the Ridge and Valley, the Appalachian Plateau, and the Blue Ridge physiographic provinces (Mount 1975). Four specimens have since been taken in the lower Piedmont. Three larval *G. porphyriticus* were collected in a small creek in northwestern Lee County. One transformed specimen (SVL=72mm) was collected in southern Lee County 6.5 km south-south-west of Auburn as it was crossing a highway during a heavy spring rain. These two new localities are ca. 62 km and 82 km east-south-east of the nearest Blue Ridge locality in Coosa County, respectively (Fig. 3).

The adult *G. porphyriticus* appears to conform with the description of *G. p. dunni* according to Brandon (1966) and Mount (1975). But as Mount (1975) pointed out, the Alabama populations of *G. porphyriticus* are apparently intergradient, showing influence of the subspecies *G. p. dunni*, *G. p. duryi* and *G. p. porphyriticus*. Specimens examined by Mount (1975) from the Blue Ridge of Alabama showed characteristics of *G. p. dunni*, with *G. p. porphyriticus* influence apparent in some populations. Additional specimens from these new localities would be required to determine whether or not there is any influence of *G. p. porphyriticus* genes in these populations.

The discovery of these amphibians in the Piedmont of Alabama is not surprising since it is known that the ranges of species or subspecies are not always delimited by specific physiographic boundaries. Folkerts (1971) stated that the physiographic boundaries of the Blue Ridge in South Carolina do not always limit the ranges of those organisms that are typically considered to be Blue Ridge forms. Wharton (1978) refers to a Piedmont environment, "Bluff and Ravine Forests of Northern Affinities", which has numerous floristic similarities to habitats in the Blue Ridge. Mount (1975) noted that the northern Piedmont and the Blue Ridge in Alabama have several features in common, and that the transition between the two regions is gradual. The fact that the ranges of these amphibians, particularly those of the two frogs, extend well into the Piedmont in Alabama further substantiates the contention that the Blue Ridge and the upper Piedmont have much in common faunistically.

The Piedmont in Alabama has been subdivided into the northern Ashland Plateau and the southern Opelika Plateau reflecting the more rugged topography of the northern portion (Johnson and Sellman 1975). Perhaps the Ashland Plateau provides the necessary habitat requirements for *Rana palustris* and *R. sylvatica* because of its montane nature. We suspect that these frogs occur throughout the Blue Ridge and the Ashland Plateau of the Piedmont and that they may be found in certain areas of suitable habitat in the upper reaches of the Opelika Plateau.

Three Amphibians in Alabama

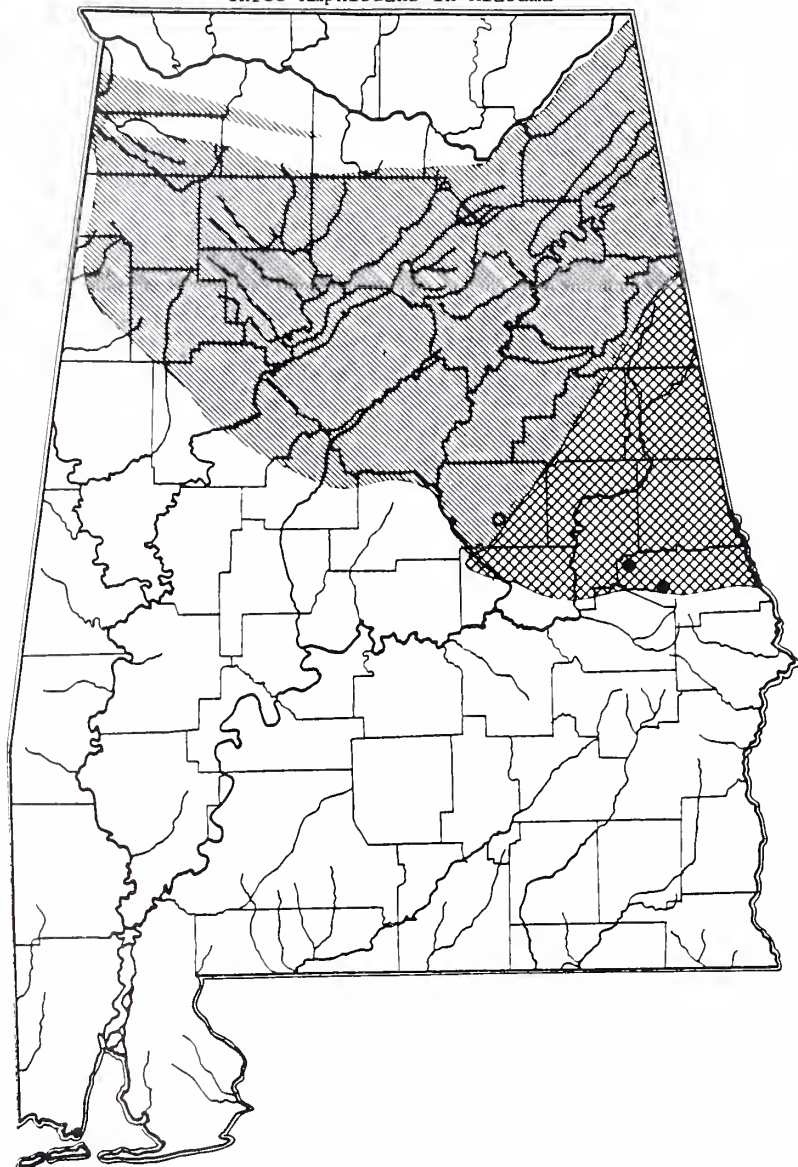


Figure 3. The distribution of *Gyrinophilus porphyriticus* in Alabama. Diagonal hatching indicates the range of the species in Alabama according to Mount (1975). Cross hatching indicates an addition to the presumed range of the species based on the present study. The solid circles represent localities from which specimens have been collected. The open circle represents the nearest previously known locality.

The adult *G. porphyriticus* was collected on the road within a few meters of a bridge above Parkinson's Mill Creek and is thought to have come from that stream. This site is situated approximately on the Fall line and is therefore probably at the southern limit of the species' range. The character of the streams as they cross the Fall Line in eastern Alabama changes rather abruptly. Above the Fall Line they are fast flowing and rocky, while below they tend to be more slow-moving with sandy bottoms. Based on our present knowledge of the range and habitat requirements of this salamander (Conant 1975, Mount 1975, Behler and King 1979), we consider it unlikely that the species inhabits the Fall Line Hills physiographic province in eastern Alabama. The spring salamander occurs sporadically in the Fall Line Hills physiographic province in the northwestern part of the state, but the habitats there are more montane in character. We suspect that the spring salamander occurs locally throughout the Piedmont in Alabama.

It is unlikely that these new localities represent recent southern dispersal by any of the three species. That they have been overlooked can probably best be explained by their sedentary nature and sporadic seasonal abundance occasioned by reproductive activity, and/or a general failure by collectors to find individuals from scattered small populations at the periphery of the species' range.

All specimens are housed in the Auburn University Vertebrate Museum.

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A TWO-HEADED SHARK FETUS, *Carcharhinus plumbeus*, (Muller and Henle)¹

Edward Rosa-Molinari
Department of Biology
Carver Research Laboratories
Tuskegee Institute
Tuskegee Institute, Alabama 36088

Abstract. A two-headed sandbar shark fetus, *Carcharhinus plumbeus* (Muller and Henle) is described. Except for the presence of two heads, the anatomy of the fetus was normal. This is the third report on the occurrence of a two-headed shark fetus and is the first report of this particular taxon.

INTRODUCTION

Necropsy of a gravid (200 cm, total length) sandbar shark, *Carcharhinus plumbeus*, which was collected on longline 6.5 km south of Pensacola, Florida, on July 23, 1980 revealed one female shark fetus with two heads (Fig. 1.) and three "normal" female shark fetuses.

Two-headed sharks have been described somewhat in the literature. Bosinceano, 1934, described two-headedness in the spiny dogfish shark, *Squalus acanthias* (Risso). Gopalan, 1971, described a fetal sumistuki shark, *Carcharhinus dussumieri*, that was two-headed. Both Bosinceano, 1934, and Gopalan, 1971, described distortion of the heads with severe edema and swelling. Underdevelopment of the gills and doubling of the dorsal and pectoral fins was also described. In both cases each head contained eyes and mouths but were not well developed. Gopalan, 1971, described the area of the juncture of the heads to be anterior to the gill slits. There was a single umbilical cord for the fetus.

RESULTS AND DISCUSSION

The two-headed fetus' total length was 37.7cm. The total lengths for the three other fetuses were 50.8, 58.9 and 60cm. All fetuses were removed from the left uterus. In the two-headed shark, *Carcharhinus plumbeus*, the heads were symmetrically aligned at a 45° angle to the plane of the body and were joined immediately behind the eyes (Fig. 1(a)). Except for the swelling of the skin, which distorted the mouth of the right head, the two heads were normal, with each having two eyes, a mouth, nostrils, oronasal grooves, spiracles, and five pairs of gills (Fig. 1(b)). There was no doubling of any

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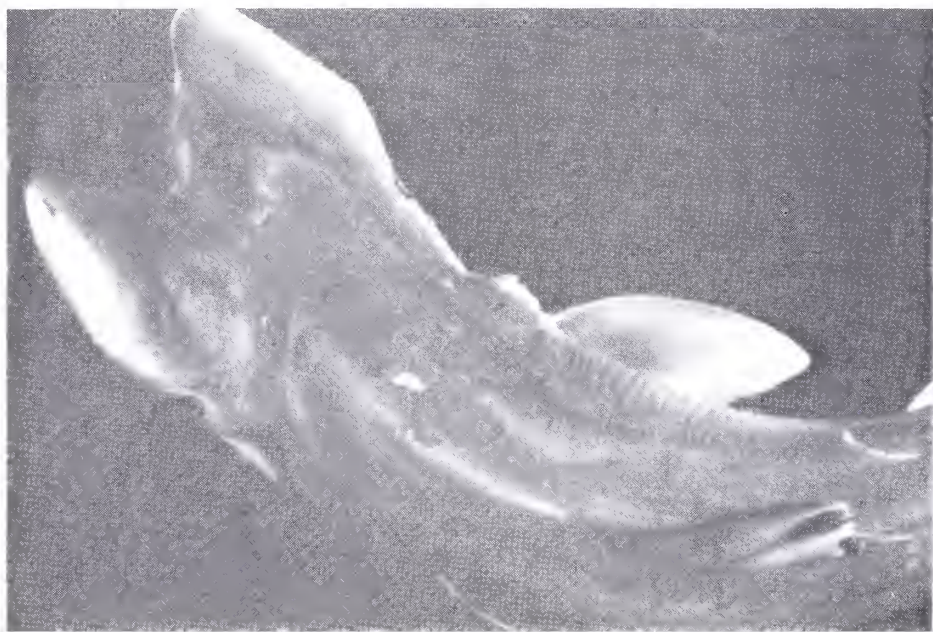


Figure 1(a). Dorsal view of the two-headed shark fetus, *Carcharhinus plumbeus*.

fins, and a single umbilical cord emerged from between the pectoral fins.

Two-headedness and twinning have been studied in various teleosts, (Gemmill, 1903; Wilder, 1904; Newman, 1917; Stockard, 1921; Dawson, 1964; 1966; 1971). Two-headedness and twinning probably occur in the late blastular and early gastrular stages of embryological development, (Roberts, 1971; Berrill and Karp, 1976) and may be the result of some peculiar uterine factor or condition (Kellicott, 1916; Stockard, 1921; Enders, 1963; Wilson, 1965; Roberts, 1971). Stockard, 1921, and Enders, 1963, have shown that delay in the growth and implantation of the eggs at critical periods of development is an essential factor for the formation of twins and two-headedness. Wilson, 1965, defines three areas to examine in twinning and two-headedness in general: causes, mechanisms and manifestations. Action by agent from the environment on germ cells, embryos, or fetuses leads to reactions within germ cells, embryos, and fetuses which then leads to pathogenesis. If such is the case, the mechanisms responsible are not fully understood.

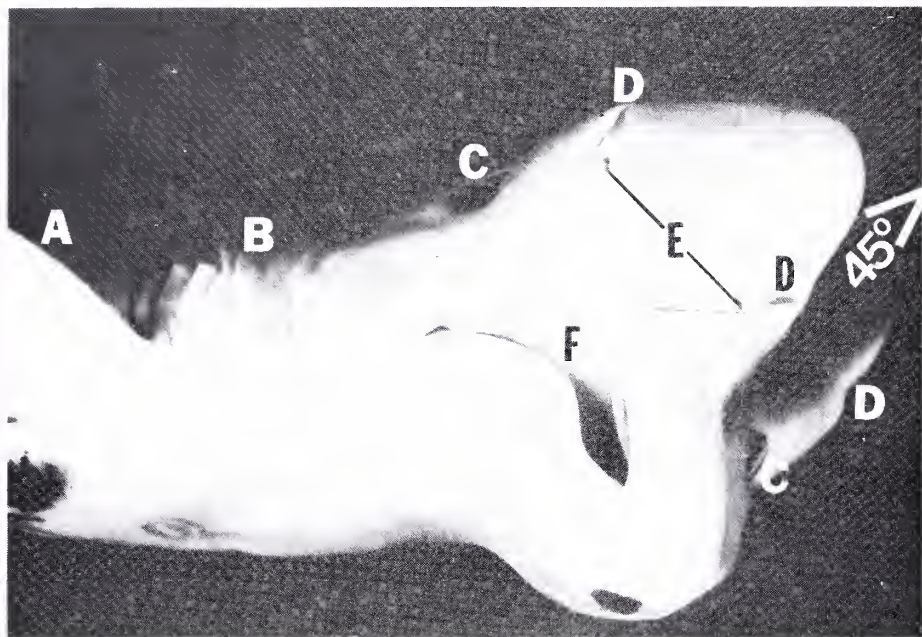


Figure 1(b). Frontal view of the right head of the two-headed shark fetus, *Carcharhinus plumbeus*. Pectoral fins (A), gill slits (B) eyes (C), nostrils (D), and, oronasal groove (E), and mouth (F).

ACKNOWLEDGEMENTS

The Author would like to thank G. D'aundre and J. L. Dobie for reviewing this manuscript, S. Allen, A. Houston, S. Jassman for technical assistance, R. Hagerty and A. Huey for photographic assistance also H. Carter and the Kenan Foundation for Support by a Research Grant-in-Aid to the Author.

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A Two-Headed Shark Fetus

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ABSTRACTS

Papers presented at the 59th Annual Meeting
University of Alabama in Birmingham
Birmingham, Alabama
March 17-20, 1982

BIOLOGICAL SCIENCES

BIOLOGICAL STUDIES OF HELIOTHIS ZEA AN INSECT PEST OF TOMATO

R. J. Jacobs and C. A. Kouskolekas. Dept. of Zoology-Entomology, Agri. Exp. Station, Auburn Univ., AL 36849

The tomato fruitworm, Heliothis zea (Boddie), is the most injurious insect pest of tomatoes in Alabama. Field and laboratory research was conducted on this pest with emphasis on natural control agents. Fruitworm larvae were collected in the field and reared on artificial diet to obtain information on parasites. Two parasitic insects were obtained: an ichneumonid wasp, that remains unidentified, and the braconid wasp Apanteles marginiventris (Cress). Approximately 20 % of the larvae collected were found parasitized. Eggs also were collected and incubated to obtain data on egg parasitism. The egg parasite Trichogramma pretiosum Riley emerged in large numbers from these eggs, at parasitization rates of up to 89 %. It was indicated that this egg parasite is a significant factor in the regulation of fruitworm populations.

VEGETABLE LEAFMINER: POPULATION FLUCTUATIONS AND PARASITISM

G. Cliff Chambers and Costas A. Kouskolekas. Dept. of Zoology-Entomology Agri. Exp. Station, Auburn Univ., AL 36849.

The vegetable leafminer, Liriomyza sativae Blanchard, has been established as a pest in Alabama during the past 6 years. It infests several cultivated and wild plants but it is particularly damaging to tomato and celery. Field research on this insect was conducted. Surveys conducted during 2 seasons helped establish trends in population fluctuations. This leafminer is attacked by a complex of hymenopterous parasites which can play an important role in regulating its populations. Ten species of parasites were collected and identified. Eulophidae was the most important family, represented by 5 species and comprising 46% of all parasites reared. A greenhouse study provided information on the relationship between L. sativae and its principle parasite Opius dimidiatus (Ashmead).

EFFECTS OF NEMATODES AND COCCIDIA IN RATS

J. C. Frandsen. USDA Regional Parasite Research Laboratory, Auburn, AL 36830.

The metabolic and nutritional effects of separate and concurrent subclinical infections by nematodes (Nippostrongylus brasiliensis) and coccidia (Eimeria nieschulzi) in rats on adequate diets have been studied by use of balance trials and carcass assays. Uninfected, pair-fed controls were used to distinguish the effects of anorexia from other, specific effects of infection. Significant anorexia occurred in rats with coccidia or both parasites beginning with the maturation of oocysts in the intestinal epithelium and concluding early in coccidial patency. This anorectic period was one day longer in doubly-infected animals than in those with coccidia alone. Rats infected only with nematodes were anorectic only on day 8, a day corresponding to no identified significant event in the course of infection. In doubly-infected animals and those with coccidia alone, the anorectic period was followed by one of significantly increased appetite. Apparent digestibilities of dry and organic matter were differently affected in singly- and doubly-infected rats, and specific effects--beyond those of differing feed consumption alone--were identified in rats with coccidia only. The infections did not affect carcass composition as revealed by differences in density or by assays for calcium and phosphorus.

DIET AND STOMACHWORM INFECTIONS IN RABBITS

R. D. Pace and J. C. Frandsen. Tuskegee Institute, AL 36088 and USDA Regional Parasite Research Laboratory, Auburn, AL 36830.

New Zealand white rabbits with low level infections on diets low in protein and carbohydrate had higher growth rates, apparent nutrient digestibilities, and nitrogen balances than did rabbits with low level infections and uninfected controls. Compared to the controls, infected animals had elevated ratios of nonessential (Gly, Ser, Glu) to essential (Val, Met, Leu) amino acids and of phenylalanine to tyrosine in the plasma. In rabbits on a diet low in both protein and carbohydrate the peroxidase activity, as a measure of inflammation, was greater with the low level infections than with the high level ones. The results suggest that the impact of stomachworm infections on the productivity of animals on diets marginal in protein and carbohydrate will be proportional to the worm burden, and that increasing the levels of these nutrients will increase the productivity of animals with low level infections.

HUMAN AND CALF CRYPTOSPORIDIA IN MICE AND RATS

N.C. Reese and W.L. Current, Dept. of Zoology-Entomology, Auburn Univ. 36849. J.V. Ernst and W.S. Bailey, USDA-AR, Auburn, AL 36830

Cryptosporidiosis was diagnosed and monitored in 12 healthy individuals who had direct contact with animals from 3 separate unrelated outbreaks of calf cryptosporidiosis. Clinical symptoms included diarrhea and abdominal cramping for 3 to 12 days. Two of the cases were asymptomatic. All of the human cases were diagnosed by the presence of Cryptosporidium sp. oocysts in the feces. The demonstration of oocysts in fecal floatations has proven to be a reliable technique for diagnosing and monitoring cryptosporidiosis. Therefore histological examination of intestinal biopsies from human subjects or of intestinal tissues obtained from animals during necropsy is not necessary for diagnosis of this disease. Fecal samples were obtained from 3 immunodeficient humans with persistent cryptosporidiosis who had undergone numerous intestinal biopsies in order to monitor their infections. Large numbers of oocysts were demonstrated in their fecal samples, and this technique is now being used to monitor these infections. Oocysts of human and calf origin were morphologically indistinguishable, and produced indistinguishable infections in suckling mice, rats, and previously uninfected calves. These data support the view that cryptosporidiosis is a zoonosis and that calves with diarrhea are a potential source of infection.

THE LIFE CYCLE OF EIMERIA ROPERI IN THE COTTON RAT, SIGMODON HISPIDUS

Suzanne A. Whitlock, William L. Current, Dept. of Zoology-Entomology, Auburn Univ., AL 36849. John V. Ernst, USDA-AR, Auburn, AL 36830.

Endogenous stages of E. roperi were studied in experimentally infected cotton rats, Sigmodon hispidus. Parasites were located in the cecum and colon deep within the epithelial cells of the crypts of Lieberkühn. The endogenous stages consisted of three generations of schizony followed by gametogony. Each schizogonous stage could be distinguished by the time of appearance, size and shape of the schizont, and number, size, shape, and arrangement of merozoites. Sporozoites were observed days one through three postinoculation (PI) and were designated as types I, II, and III on the basis of number and size of the posterior refractile bodies. Gamonts appeared on day six PI and mature macrogametes and microgametocytes by day eight PI. Eimeria roperi oocysts were collected directly from the intestinal tract of experimentally infected cotton rats. Oocysts were allowed to sporulate at various temperatures, examined at different time intervals, and classified as to stage of development. The mean percentage of oocysts at each stage of sporulation during incubation at the various temperatures was tabulated. Sporulation of E. roperi oocysts occurred when incubated at 20, 25, and 30C and the thermal death point was 37C.

Abstracts

ASPECTS OF THE FLORA AND FAUNA OF LIMESTONE SPRINGS IN THE RIDGE AND VALLEY PHYSIOGRAPHIC PROVINCE IN ALABAMA

Thomas R. Jones. Alabama Cooperative Wildlife Research Unit, Auburn University, AL 36849.

Limestone and dolomitic springs are common in the Ridge and Valley physiographic province in northeastern Alabama, but the biota of the springs has been poorly studied. Thirty-six springs were surveyed and the more conspicuous floral and faunal elements present in each were identified. A non-native aquatic plant, Nasturtium officinale, is the dominant feature in most free-flowing spring habitats. Frequent plant associates include: Mentha spicata, Ludwigia palustris and Fissidens fontanus. Commonly encountered macroinvertebrates, in decreasing order of abundance, are amphipods, snails (primarily Goniobasis carinifera), and crayfish. Cottus carolinae, Semotilus atromaculatus, various darters (Etheostoma spp.), and larval salamanders, Eurycea spp. and Pseudotriton ruber were the most common aquatic vertebrates. Desmognathus fuscus was the most frequently collected amphibian, while Regina septemvittata and Nerodia sipedon were the only reptiles that were collected regularly. Limestone springs in this region appear to exert an insulating affect on their fauna as evidenced by several endemic organisms. Cottus pygmaeus and its principle food source, Stiobia nana, are known only from Coldwater Spring in Calhoun County. Etheostoma nuchale has been found in four springs in Jefferson County. Etheostoma ditrema is an obligate spring inhabitant in much of the region, and Eurycea aquatica is found in certain springs north of the Coosa River throughout the Ridge and Valley in Alabama.

ENDOGENOUS DEVELOPMENT OF CALF CRYPTOSPORIDIUM SP. IN MICE

William L. Current and Norman C. Reese, Department of Zoology-Entomology, Auburn University, AL 36849

Three-day-old white mice were inoculated orally with oocysts of Cryptosporidium sp. isolated from a calf. Two mice were necropsied at 4, 8, 12 and 16 hr post inoculation (PI) and then 2 mice were necropsied every 24 hr from day 1 through 9 PI. Sporozoites were observed in mucosal scrapings of the small intestine obtained 4, 8, 12 and 16 hr PI. Trophozoites, immature schizonts and mature schizonts with 8 merozoites were seen in small intestinal tissues by 16 hr PI. Mature schizonts observed in mucosal scrapings, 1- μ m-thick plastic sections, and in thin sections prepared for transmission electron microscopy (TEM) contained 8, 4, or 6 merozoites. Sexual stages were present in small intestinal tissues obtained days 4-9 PI. TEM revealed that all endogenous stages were in a parasitophorous vacuole within modified microvilli. Schizonts, macrogametocytes, and microgametocytes could be distinguished by TEM. Sporogony occurred within the host tissues which resulted in oocysts containing 4 sporozoites and a large residuum. Ultrastructure of endogenous stages of the calf isolate of Cryptosporidium will be compared with that of several human isolates.

Abstracts

FOOD CONSUMED BY FALL ARMYWORM PARASITIZED BY OPHION FLAVIDUS

W. Mitchell Rohlf and T. P. Mack. Dept. of Zoology-Entomology, Agric. Exp. Station, Auburn Univ., Auburn, AL 36849.

The fall armyworm (FAW) is a serious pest of corn, sorghum and turf in Alabama. Reed (unpublished M. S. thesis) reported the Ophion flavidus (Hymenoptera: Ichneumonidae) was the most common insect parasite of FAW in Alabama in 1978-79. Many larval parasites such as O. flavidus do not cause their hosts to cease feeding immediately and may even cause increased food consumption. Food consumption by unparasitized FAW and FAW parasitized by O. flavidus was measured by allowing larvae of known weight to feed ad lib on pre-weighed diet plugs. Corrections for water evaporation were made using control plugs held identically. Tests were conducted at 80°F with 16/ 8 L/D photoperiod. Two size groups (.05 - .10g and .15 - .20g) of larvae were exposed for 24h to O. flavidus females. Additional larvae of each size class were handled identically but were not exposed to a parasite. Final weight of food consumed was determined at larval pupation or parasite emergence. Smaller larvae consumed significantly more diet than did larger larvae in both parasitized and unparasitized groups. Parasitized larvae appear to consume less than unparasitized larvae (least square means of 149 mg by parasitized FAW and 201 mg by unparasitized FAW), but this difference could not be shown to be significant due to variation associated with the water loss correction term. This experiment is being replicated with technique modifications designed to reduce this variation.

LIFE CYCLE OF ISOSPORA SUIS OF SWINE

David S. Lindsay and William L. Current, Dept. of Zoology and Entomology, Auburn Univ., AL 36849. John V. Ernst*, USDA-AR, Auburn, AL 36830.

Sporogonous development of Isospora suis of swine was determined using established guidelines. Uninucleate sporonts underwent nuclear division, became binucleate, and then divided to form two round uninucleate sporoblasts. Binucleate sporoblasts elongated to form binucleate sporocysts, each of which then gave rise to four sporozoites. Sporulation was completed within 56 hr at 20C, 40 hr at 35C, 16 hr at 30C, and 12 hr at 37. When sporocysts were freed mechanically from the oocysts and exposed to excysting solution, movement of the sporozoites was seen inside the sporocyst within 5 minutes. Indentations in the sporocyst wall became apparent and total of partial collapse of the sporocyst wall followed. Immediately following collapses of the sporocyst wall, released sporozoites were sluggish but they became more active after incubation in excysting solution. The early endogenous development of I. suis was also studied to supplement an earlier report which described stages from 1.5 to 10 days post inoculation. Sporozoites were seen inside epithelial cells at 10 hr postinoculation. Stages seen at 20 hr postinoculation were sporozoites, binucleate Type 1 meronts and Type 1 merozoites indicating that merogony takes place 24 hr earlier than previously described.

Abstracts

LEUCINE POOLS IN NORMAL AND DYSTROPHIC CULTURED MUSCLE CELLS

Peter A. Schneible and Ronald B. Young. Department of Biological Sciences, University of Alabama, Huntsville, AL 35899

Muscular dystrophy is characterized by changes in protein metabolism and in plasma membrane structure and function. The specific radioactivity (SRA) of leucine in the extracellular, intracellular and aminoacyl-tRNA pools of normal (White Leghorn) and dystrophic (line 307) embryonic chick breast muscle cultures was examined in order to assess possible changes in leu pools and their relationship to alterations in protein metabolism. Myogenic cell cultures at steady state with respect to protein synthesis and breakdown (i.e., 7-8 days) were employed for all experiments. The SRA of leu pools was determined at various times up to 30 min after addition of ^3H -leu to the external medium by reaction with ^{14}C -dansyl chloride and subsequent two-dimensional chromatography on polyamide thin layer plates. The extracellular SRA in dystrophic cell culture medium was decreased by approximately 60% compared to medium exposed to normal cells at all time points. Both the intracellular leu and leu-tRNA pools reached steady state by 5 min after label administration. Under steady-state conditions leu-tRNA SRA was greater than or equal to intracellular leu SRA in normal and dystrophic cultures. However, both leu-tRNA and intracellular leu SRA were 40-55% lower in dystrophic cells than in normal cells. These significant differences observed in amino acid pools between normal and dystrophic muscle cells must be taken into account when calculating rates of protein synthesis and breakdown. (Supported by Muscular Dystrophy Association and NIH AM30823).

FINE STRUCTURE OF THE TESTICULAR SPERMATOOZOA FROM THE CHANNEL CATFISH, ICTALURUS PUNCTATUS

Nanette Nicholson and Gary R. Poirier. Dept. of Biology, University of Alabama in Birmingham, Birmingham, AL 35294.

The morphology of the spermatozoa from the testes of the catfish Ictalurus punctatus was studied by transmission and scanning electron microscopy. The spermatozoa are of the primitive type with short round heads but with no acrosomes. They are biflagellated and have elaborate midpieces. The axonemes have a 9 + 2 pattern but lack the typical accessory structures. Both centrioles function as basal bodies. A centriolar cap extends from the proximal end of each centriole while satellite-like structures surround the distal portion. Microtubules that extend from the satellites radiate throughout the length and width of the midpiece. Double-walled invaginations, appearing as vacuoles in section, are distributed throughout the midpiece. The mitochondria are located at the periphery of the midpiece with no direct connection to the flagellar apparatus.

EFFECTS AFTER LONG-TERM USE OF 2,4-D IN LAKE GUNTERSVILLE.

R. F. Modlin, Dept. of Biological Sciences, J. M. Harris and R. Congo, Dept. of Chemistry, Univ. of Alabama in Huntsville, Huntsville, AL 35899.

For the past 20 years the Tennessee Valley Association has used 2,4-dichlorophenoxyacetic acid (2,4-D) to manage watermilfoil Myriophyllum spicatum. A total of 1.2×10^6 kg of 2,4-D has been used to treat Lake Guntersville Reservoir, Tennessee River. In 1969 a survey monitored the impact of 2,4-D on the Lake Guntersville ecosystem. Past records, the 1969 survey and the perfection of High Pressure Liquid Chromatography provided an opportunity to examine the possible accumulation of this herbicide in water, hydrosol, plant and fish tissues after its long-term use. Events associated with the 1980 application of 2,4-D to Lake Guntersville were monitored at four of the same sites used during the 1969 survey. One site, North Sauty Creek, was intensively monitored. Average pretreatment 2,4-D concentrations in the water were 0.026 mg/L. Posttreatment events were similar to those observed during the 1969 survey. Concentrations in the water and in the hydrosols decreased rapidly. Watermilfoil appeared to actively absorb and concentrate large quantities of 2,4-D because this herbicide mimics auxins. Very low 2,4-D levels were observed in fish tissues. Results tend to indicate the 2,4-D is innocuous, but may accumulate and/or be recycled after long-term use. Factors that suggest recycling or accumulation of residual amounts of this herbicide are discussed.

COMPARATIVE MICROSCOPY OF SKELETAL MUSCLE FIBERS

Kirtley Yearwood, John W. Williams, III and Carol S. Williams. Dept. of Biology, Tuskegee Institute, Tuskegee Institute, AL 36088.

Male and female Rhode Island Red chickens from a single hatch were sampled such that birds over a wide range of age (10 to 52 weeks) were obtained. Birds were exsanguinated via the jugular vein, scalded at 65°C for 30 seconds per pound body weight, plucked, eviscerated and washed. Birds were placed in sealed plastic bags and held for 24 to 30 hours. All birds were cooked to an internal temperature of 88°C in a microwave oven. Breast muscle (pectoralis major) samples were taken for observation of sarcomere distances using brightfield, phase contrast, interference contrast (Nomarski) and transmission electron microscopy. For phase contrast and Nomarski observations, small unfixed, unstained portions of muscle were teased, homogenized and "squashed" on a glass slide in Sorenson's buffer (pH=6.8) made 60% in glycerol. Samples for TEM were fixed in phosphate buffered Karnovsky's glutaraldehyde/paraformaldehyde fixative, post-fixed in 2% osmium tetroxide and en bloc stained with uranyl acetate. Results with all types of microscopy indicate that sarcomere lengths decrease with age. Sarcomere lengths are significantly ($P < 0.05$) shorter in older birds (both male and female) when compared to those in younger birds. (Supported by USDA/SEA/CR Grant # AL.X-3-CSW-04.)

Abstracts

THE INTERACTION OF SOYBEAN CYST NEMATODE AND RHIZOBIUM JAPONICUM ON SOYBEAN YIELD

Diann Jordan and McArthur Floyd. Dept. of Natural Resources, AL. A & M Univ., Normal, AL. 35762.

Greenhouse studies were conducted to examine the interaction of soybean cyst nematode and rhizobium japonicum on soybean germplasm line. A consideration was given to nodule number, nodule weight, root weight, percent nitrogen, and efficiency of nitrogen-fixation. There was no significant difference for nodule number and root weights for experiments I and II (.05 probability level). In experiment I, there was no significant difference observed in percent nitrogen for treatment or variety. In both experiments I and II, there were significant differences observed for nodule weight for treatment, variety, and variety-treatment interaction. Further studies are presently being conducted to evaluate the interaction of cyst nematode and rhizobium.

ULTRASTRUCTURAL DAMAGE IN TISSUES EXPOSED TO PCBs

Broderick C. Jones and Carol S. Williams. Dept. of Biology, Tuskegee Institute, Tuskegee Institute, AL 36088. Ronald A. Chung. Dept. of Food Science and Nutrition, Tuskegee Institute, Tuskegee Institute, AL 36088.

Various subclinical levels of selected polychlorinated biphenyls (PCBs) were administered intramuscularly to rabbits and goats in sequential injections over a treatment period. Tissue samples of livers were taken for ultrastructural observation. Coarse alteration of the liver which included proliferation of the smooth endoplasmic reticulum was observed. Hepatocyte cytoplasm appeared to be leached out. Mitochondria displayed a dense matrix void of cristae. More deleterious effects resulted at higher dose levels and with compounds of higher chlorine content.

(Supported by NIH/MBS Grant # 5S06 RR08091-09.)

AVOIDANCE RESPONSE OF THE SPORANGIOPHORE OF PHYCOMYCES

William Chitwood, Dorothy E. Sherrill, and Robert S. Lishak, Dept. of Zoology-Entomology, Auburn University, AL 36849

A time-lapse photographic technique was used to study the growth and orientation of Phycomyces sporangiophores. The experimental design included evaluation of positive phototropic responses and differential growth resulting from the presence of a barrier placed near the specimen. Methodology was developed for use in testing further, the chemical self-guidance hypothesis in a convection-free environment.

IMMUNOFLUORESCENT LOCALIZATION OF AN ACROSIN INHIBITOR FROM
MURINE SEMINAL VESICLE

Michael H. Irwin and Gary R. Poirier. Dept. of Biology, University of Alabama in Birmingham, Birmingham, AL 35294.

Antibodies to a low molecular weight (6400), acid stable proteinase inhibitor (of acrosin and trypsin) from murine seminal vesicle was produced in a rabbit. Antibody specificity was determined by double diffusion, immunoelectrophoresis, and the ELISA plate-binding assay. Using the indirect immunofluorescent technique, fluorescent staining was observed in the epithelial cells and lumen of seminal vesicle tissue (deparaffinized sections), but not in tissue from the testis, epididymis, prostate, Cowper's gland or liver. Sperm recovered from the female reproductive tract within 5 minutes after coitus showed fluorescence associated with the acrosomal region. Of the sperm retrieved from the female 2 hours post-coitus, only 20% of uterine sperm and no oviducal sperm show fluorescence. Untreated cauda epididymal and ductus sperm show no fluorescence. In vitro incubation of these sperm with either a pure seminal vesicle inhibitor preparation or a crude seminal vesicle homogenate leads to fluorescence associated with the acrosomal region in 80-90% of these sperm. These data suggest that this low molecular weight proteinase inhibitor is produced only in the seminal vesicles and attaches to sperm at or during ejaculation and is removed during storage in the female reproductive tract.

FEMALE REPRODUCTIVE CYCLE OF STERNOTHERUS MINOR DEPRESSUS

Close, David K. and Ken R. Marion. Dept. of Biology, Univ. of Ala. in Birmingham, Birmingham, AL 35294.

Seasonal reproductive changes were studied in the female flattened musk turtle, Sternotherus minor depressus, during 1979 and 1980 in north-central Alabama. Vitellogenesis begins in late July-early August and continues through mid-fall. There is no apparent vitellogenic activity from late fall-early spring. By mid-spring, there is a resumption of vitellogenesis, and final maturation of follicles in preparation for ovulation. Ovarian mass is maximal just prior to ovulation of the first clutch of eggs. Oviposition of the first clutch occurs in late May-early June. Following this, the largest follicles undergo final maturation for ovulation of the second clutch, with oviposition occurring from mid June-early July. Most individuals lay two clutches per season; however, some females may lay three. All oviposition ceases by mid-July. Ovarian mass is minimal following ovulation of the final clutch. The mean clutch size of animals studied was 2.19, with a range of 1-4.

RECEPTOR INTERACTION AND UTERINE RESPONSIVITY

P. S. Campbell, G. A. Newman, and G. C. Loveless. Dept. of Biological Sciences, University of Alabama in Huntsville, Huntsville, AL 35899.

The extent of uterine fluid imbibition and long-term uterine growth has been previously correlated with the degree of receptor-estrogen (REC) retention in the nucleus at specific times after estrogen injection. Dexamethasone antagonizes the estradiol-induced fluid uptake and true uterine growth, while diethylstilbestrol (DES) stimulates less fluid transport but greater uterine growth than estradiol. However, the differential effects of these two synthetic hormones upon the two uterotropic responses in the immature rat are not paralleled by an appropriate temporal pattern in the nuclear REC profile compared to estradiol treatment. Furthermore, the antimicrotubular agent vinblastine sulfate completely blocks fluid imbibition with no reduction in nuclear REC. Consequently, combination antiestrogen/estrogen administration with subsequent measurement of fluid imbibition in relation to receptor availability after antiestrogen and nuclear REC retention after estradiol injection was employed to ascertain the degree to which fluid uptake may be coupled to nuclear REC interaction. Injection of 1 μ g estradiol 30 min after an injection of 10 μ g DES or 50 μ g of the antiestrogen CI-628 or nafoxidine produces additional fluid imbibition. The percent increase in the 3 hr wet weight of the uterus promoted by the estradiol injection does not appear to be accounted for by available cytoplasmic hormone binding sites. Also, the additional response elicited by estradiol is not accompanied by elevation of nuclear REC over the initial treatment. Hence, fluid uptake may be related more to estrogen-induced blood flow and/or membrane changes than cytoplasmic/nuclear REC events.

Ovipositional rates of Pseudoplusia includens(Walker)(Lepidoptera: Noctuidae) as a function of temperature.

Linda Jean Mason and T.P. Mack. Dept. of Zoology-Entomology, Auburn Univ., Auburn, Al. 36849.

The soybean looper (SBL) is a serious defoliator of soybeans in Alabama. In order to establish a working management model for the SBL, basic information is needed on reproduction as a function of temperature. The ovipositional rate of the SBL was measured at five different temperatures to determine the temperature threshold for oviposition and the total number of eggs oviposited at a given temperature. Rates were measured at 12, 14, 22, 35, and 38°C with 14/10 L/D photoperiod. Humidity was maintained at ca. 75%. Six ovipositional containers were used at each temperature, with two males and two females per container. A trial continued until one of the SBL died. It was found that the temperature thresholds were 12 and 38°C and that near the temperature thresholds the daily egg production was sporadic and varied. This experiment is being replicated with technique modifications to include more temperatures between the thresholds.

TEMPERATURE DEPENDENCE IN POIKILOTHERMS

T.P. Mack, Department of Zoology-Entomology, Auburn University, Auburn Univ., AL 36849

Many mathematical expressions have been used to describe the reaction of poikilotherms to temperature changes. Most of these have been derived from enzyme kinetic equations, since temperature has been shown to greatly affect enzyme catalyzed reactions in poikilothermic organisms and plants. These equations typically have been applied in situations where temperature is the sole factor limiting growth and/or development. Some researchers have attempted to broaden the predictive range of these models by multiplying an enzyme kinetics equation by another function to quantify the interaction of temperature and a limiting nutrient on poikilothermic growth. These have met with limited success. Temperature-mediated functional response equations offer a viable and tested means of quantifying the interaction of temperature and a limiting nutrient on growth and development rates for poikilothermic organisms and plants. These equations broaden the predictive range of models that ordinarily do not quantify such interactions. They contribute to the understanding of the population dynamics of poikilotherms by providing a mathematical description of a mechanism for fine tuning multiple species interactions. Temperature-mediated functional response equations also add stability to multispecies interaction models by adding complexity and uncertainty to the models.

LIGHT AND TEMPERATURE EFFECTS ON GROWTH OF CRYPTOMONAD ALGAE

Cherly Stanley and Margaret Miller. Dept. of Biology, University of South Alabama, Mobile, AL 36688

The rate of growth of three species of marine cryptomonad algae (Cryptophyta) were compared under four different light-temperature settings formed by combining either low light (100 ftc) or high light (350 ftc) with either low temperature (16 C) or high temperature (23 C). Growth was measured as increases in cell density and optical density. Growth rates were obtained by regression and expressed as divisions per day. Results were compared for statistical differences using analysis of variance and L.S.D. techniques. The high light, high temperature setting gave significantly greater growth in all cases, followed by the high light, low temperature setting. Highest growth rates in divisions per day were: Chroomonas silina, .71; Cryptomonas sp. (M2), .66; Cryptomonas sp. (Stan M2), .65. The low light, high temperature setting gave poorest growth, but was not significantly different from the low light, low temperature treatment.

Abstracts

WIND STRESS AND WOOD DENSITY IN A TROPICAL RAIN FOREST

R. O. Lawton. Dept. of Biological Sciences, Univ. of Alabama, Huntsville, AL 35899.

Wind strongly influences the characteristics of montane rain forest trees. Wood densities were determined for 32 species of canopy trees from the virgin forests along the crest of the Cordillera de Tilaran (1500 m a.s.l.) in northwestern Costa Rica. Habitat preferences were used to sort the trees into three groups: (1) those of protected coves, (2) those of more exposed slopes, and (3) those of ridge crests. Measurements of wind speed profiles show that wind stress is greatest on the ridge crests, least in the coves, and intermediate on the slopes. Analysis of wood densities shows that species of the ridge crests and slopes generally have denser woods than those of the coves. Shade-intolerant trees have lighter woods than shade-tolerant trees from the same site, but the difference is most marked for cove trees and least marked for ridge crest species. Two shade-intolerant trees were analyzed further. Didymopanax pittieri grows on ridge crests and upper slopes; individuals on the ridge crests have denser wood than those of similar size on the upper slopes. Heliocarpus appendiculatus grows in treefall clearings in coves; as individuals grow up into the windier conditions of the forest canopy they produce denser wood. So in tropical montane rain forests mechanical adjustments to wind include (1) adjustments within individuals as they grow, (2) site-dependent differences among individuals of a species, and (3) habitat related differences among species.

DEVELOPMENT OF EIMERIA FUNDULI IN FUNDULUS HETEROCLITUS

S.J. Upton. Auburn Univ., AL 36849, and D.W. Dusaynski, Univ. of New Mexico, Albuquerque, NM 87131.

Laboratory reared Fundulus grandis and F. heteroclitus were experimentally infected with Eimeria funduli by being fed Palaemonetes pugio (grass shrimp) collected from endemic areas. Histological studies of liver, hepatopancreas, spleen, gall bladder, kidney, intestine, per-intestinal fat, reproductive organs, and brain from fish sacrificed at 1, 2, 6, 12, 18, and 24 hrs and 2, 5, 10, 15, 20, 25, 30, 35, 40, and 45 days after consuming naturally infected shrimp showed a single schizogonous generation first seen five days after the infective meal. No developmental stages were positively identified in the tissues of experimentally infected fish prior to day five. Mature schizonts were found 10 days post-infection and contained 13-26 (16) merozoites. Gamonts appeared on day 15 and fertilization occurred between 15 and 20 days. After sporoblast formation, sporopodia appeared during sporocyst wall formation, about day 25. Sporozoite formation was completed by day 45 in most sporocysts.

VARIATION WITHIN AND AMONG TWO SPECIES OF BLARINA

Larry L. Crowell. Dept. of Zoology-Entomology, Auburn University, AL 36849.

The genus Blarina (Mammalia: Insectivora: Soricidae) is represented in the east central portion of Alabama by at least two geographical populations that are differentiated by craniometric characters. The larger has been referred to as Blarina brevicauda, and the smaller as Blarina carolinensis. A preliminary examination of both forms revealed variation in the taxonomic attributes of each species, and craniometric variation which appears to be clinal within each species range. The purpose of this study is to search for areas of geographical contact, or overlap, in order to delineate further the distribution of the shrews and their taxonomic relationships within the genus Blarina. Methods to be used in order to separate individual and geographical variation are discussed.

BEHAVIORAL ASPECTS OF MEDITERRANEAN GECKOS AT EUFAULA, ALABAMA.

William R. Gates and Larry L. Crowell. Dept. of Zoology-Entomology, Auburn University, AL 36849.

Behavior of Mediterranean geckos (Hemidactylus turcicus) was observed during a study conducted to estimate their population size at a site in Eufaula, Alabama. The geckos retained their ability to move rapidly on vertical surfaces after being marked by toe clipping. Escape behavior was found to be complex even though predators were scarce. Fighting was seen twice—once between mature males and a second time between juveniles. Scars and/or injuries are associated with this combat in males and juveniles and with breeding behavior in females. Much of the behavior of H. turcicus is similar to the behavior of the common half-toe gecko (H. frenatus).

GRAY SQUIRREL MATING CALLS

Robert S. Lishak. Dept. of Zoology-Entomology, Auburn Univ., AL 36849

Previous research based on onomatopoeic descriptions of gray squirrel (Sciurus carolinensis) mating calls led to the conclusion that they are essentially the same as the "muk-muk" call produced by nestlings. In the present study, mating calls were recorded and characterized spectrographically and are compared to the muk-muk call. Analysis reveals that the mating calls appear to be neotenic but they are morphologically dissimilar to their ontogenic predecessors and message continuity between the two should not be assumed.

Abstracts

INTERACTION BETWEEN CANDIDA ALBICANS BLASTOSPORES AND PHAGOCYTIC CELLS

W.H.Kidd and J.M. Clark. Dept. of Biological Sciences, Univ. Alabama in Huntsville, Huntsville, Ala. 35899. Z.A.Evans. Univ. Texas Health Science Center at Dallas, Dallas, Texas 75235.

In vitro studies have demonstrated that Candida albicans blastospores attach to oral mucosa cells and are phagocytized by a number of cell types including polymorphonuclear neutrophils, monocytes and macrophages. Fibroblasts are also phagocytic but are classified as non-professional phagocytes. We have investigated in vitro phagocytosis of Candida blastospores by L-929 fibroblasts and in vivo phagocytosis of blastospores by mouse connective tissue fibroblasts using the mouse connective tissue air pouch. L-929 fibroblasts and connective tissue fibroblasts are able to phagocytize blastospores, latex beads and Streptococcus pyogenes cells. Phagocytosis of Candida blastospores was confirmed by electron microscopy. Tissue culture L-cells as well as connective tissue fibroblasts phagocytized viable blastospores within 2 to 3 hr following challenge. Intracellular blastospores were capable of growing and forming germ tubes within the fibroblasts. The significance of fibroblast phagocytosis of C. albicans in the pathogenesis of Candida infections is open to question. The possibility exists that fibroblasts may trap Candida in tissue, such as the kidney, during an infection. The connective tissue air pouch model should prove of value in studying in vivo cellular responses to Candida albicans.

FOOD AVAILABILITY AND THE USE OF SPACE BY EASTERN CHIPMUNKS

Mark S. Blackmore and Robert S. Lishak. Dept. of Zoology-Entomology, Auburn University, AL 36849.

Spatial use by a population of eastern chipmunks was assessed via direct visual observation in the spring of 1981. Three successive phases, each 3-weeks long, were employed to evaluate the effects of the distribution of food on home range and core area. The environment was unaltered during the first and third phases, but in the second phase sunflower seeds were applied by a mechanical spreader to increase both the amount and homogeneity of food over one-half of the study area. The means for the sizes of the home range, daily range, and core area for the manipulative phase did not differ significantly from the phases either preceding or following food enrichment. Individuals exhibited patterns of food exploitation that were in accordance with theories of optimal foraging. The size and shape of the home range and core area appear to be affected by the distribution more than the amount of food.

IMMUNE STATUS OF MICE CHRONICALLY INFECTED WITH GROUP A STREPTOCOCCI

R. Chukwuocha and J.M.Clark. Dept. of Biological Sciences, Univ.Ala. in Huntsville, Huntsville, Ala. 35899. Z.A. Evans. Univ. Texas Health Science Center at Dallas, Dallas, Texas 75235.

Streptococcus pyogenes has been related to chronic disease states such as rheumatic fever and arthritic conditions. Retention of bacterial cell wall material by cells, such as macrophages, has been implicated with pathological processes and arthritic states have been induced in rats by injection of cell wall components. We have developed an animal model for study of chronic Streptococcal infections using the mouse connective tissue air pouch. Swiss-Webster mice challenged with as few as 10^4 CFU of bacteria develop a chronic infectious process as indicated by recovery of viable bacteria from connective tissue of air pouches for at least 5 months. The immune response of infected animals to Streptococcal antigens has been examined to discern how bacteria may escape destruction by host resistance mechanisms. Infected mice demonstrate a significant increase in antibody titer to Streptococcal antigens, demonstrate a cellular immune response to cell wall antigens as determined by foot pad and air pouch assays and have enhanced macrophage activity against Streptococci. As infected animals respond with humoral and cell mediated immunity to bacterial antigens but can not clear the bacteria from the tissues, it is suggested that bacteria may escape destruction by residing within connective tissue fibroblasts.

A GENETICIST'S VIEW OF THE CREATIONISM CONTROVERSY

Mary Ball, Dept. of Zoology-Entomology, Auburn Univ., Auburn, AL 36849

The claims of the so-called Scientific Creationists point out some weaknesses in many college-level textbooks. For example, creationist literature quotes biology textbook statements that "mutations are rare, recessive, and almost always harmful changes in DNA" as evidence that mutation is inadequate as a source of the genetic complexity in nature. Adequate treatment of this question should include evidence that (1) mutation rates are not constant, (2) when whole individuals or species are considered, mutations are common, not rare, (3) at the level of transcription, the term "recessive" is meaningless, (4) over half of all possible codon changes result in no change or in a conservative change in an amino acid sequence coded, (5) mutations are neither beneficial nor harmful in the abstract, (6) changes in environmental factors and/or gene arrangement can affect gene expression, and (7) gene duplication followed by divergence increases gene diversity. Analogies which compare mutation to an event such as randomly changing the wiring in a TV set should be avoided because such a change is clearly likely to be unconditionally disastrous. Perhaps no single analogy can capture the essence of mutation.

Abstracts

JUVENILE HORMONE INDUCTION OF CRICKET VITELLOGENIN SYNTHESIS

Helen H. Benford and James T. Bradley, Department of Zoology-Entomology, Auburn University, Auburn, AL 36849

The production of vitellogenins (Vg), female-specific hemolymph precursors to egg-yolk proteins, by the insect fat body is controlled in many species by juvenile hormone (JH). The mechanism by which JH acts to induce fat body tissue is unknown. Our ultimate goal is to examine fat body for putative regulatory proteins during the induction event in Acheta domesticus. In order to pursue such a study, it was necessary first to determine the timing of fat body induction and Vg production during normal development and to demonstrate that JH is the inducing hormone in the cricket. Hemolymph samples were assayed for Vg by Ouchterlony double diffusion at various times after the adult molt. No Vg was detectable during the first 12 hours of adult life, but by 36 hours, 100% of the assayed animals were positive. An appropriate time frame for attempting Vg induction with exogenous JH was defined by ligation experiments in which endogenous hormone centers were removed. Accordingly, at 4 hours after the adult molt, females were decapitated and injected with JH I in paraffin oil or with oil alone. The number of animals positive for Vg when assayed at 44 hours after JH injection was dose-dependent, 4 ug being the optimal dose tested (91% positive). None of the oil-injected controls produced Vg. Thus we have shown that exogenous JH can stimulate Vg production in Acheta and have provided the basis for future studies of the induction mechanism. (Supported by NIH National Research Service Award 1F34GM07235 from the National Institute of General Medical Sciences and by the Auburn University Agricultural Experiment Station).

REASSESSMENT OF THE DISTRIBUTION OF THREE AMPHIBIANS IN ALABAMA

Mark S. Davis and Thomas R. Jones. Department of Zoology-Entomology, and Alabama Cooperative Wildlife Research Unit, Auburn University, AL 36849.

Little information has been published concerning the distribution of Alabama amphibians since the publication of the state herpetology in 1975. New localities for three amphibians, Rana palustris LeConte, Rana sylvatica LeConte, and Gyrinophilus porphyriticus (Green) were discovered while conducting field work in eastern-central Alabama during 1978 and 1979. These localities represent range extensions into the Piedmont physiographic province which was previously thought to be uninhabited by two of the three species. Rana palustris and Rana sylvatica probably occur throughout the Ashland Plateau region of the Piedmont. Gyrinophilus porphyriticus may occur locally throughout the Piedmont but it is probably exceedingly scarce in that portion of its range.

Abstracts

ENERGETIC EXPENSE OF HIBERNATION IN CNEMIDOPHORUS SEXLINEATUS

Lawrence C. Wit, Jeffrey C. Sellers, and Isabel M. Ragland
Department of Zoology and Entomology, Auburn University, AL 36849

The oxygen consumption of hibernating C. sexlineatus was evaluated at 10, 20, and 30° C. The equation representing the relationship between oxygen consumption and body temperature in hibernating C. sexlineatus can be expressed as $\log_{10} O_2 = -1.325 (\bar{T}) + 0.047$. The average body temperature (\bar{T}) throughout the hibernating season was determined by continuous measurements of burrow temperature. These measurements revealed that the "average" temperature experienced by C. sexlineatus was 15.4° C for males and 15.5° C for females. From these data it was calculated that the energetic cost of hibernation is 6.6 kcal/season for males and 7.3 kcal/season for females. Stored energy in the form of abdominal fat bodies, even if it were all used, is insufficient to pay the energetic cost of hibernation.

PLANT PROPAGATION FOR CLASSROOM USE FROM SUPERMARKET FRUITS, SEEDS AND VEGETABLES

Thomas Cochis and Kenneth E. Landers. Dept. of Biology, Jacksonville State Univ., Jacksonville, AL 36265.

A demonstration was presented on plant propagation for the classroom using common supermarket fruits, seeds and vegetables. Examples included orange, grapefruit, lemon, avocado and pineapple. The use of bean, pea, peanuts and watermelon seed was also discussed. Propagation with vegetables included the carrot, sweet potato, Irish potato and onions. The anatomy of the various plant organs was discussed along with the various propagation techniques. Mature plants of some species were shown. Some of these also make valuable houseplants.

GROWTH, PROPAGATION, AND PRESERVATION OF FIGS IN NORTH ALABAMA

Kenneth E. Landers, and Thomas Cochis. Dept. of Biology, Jacksonville State University, Jacksonville, AL 36265.

Figs for home use are frequently grown adjacent to building foundations in North Alabama. Cold weather damage is apparently reduced by mulching and using a building or hedge as windbreak. Cuttings are easily rooted and used as a source of new plants. Fruits may be eaten fresh, canned as preserves, or dried for use in cakes. Commercial production of figs does occur, but may not be highly successful due to lack of market and a large home production.

CHEMISTRY

THE SYNTHESIS OF NEW DIALKYL DERIVATIVES OF 5-HYDROXYHAEMOPYRROLE

Philip E. Morris and John M. Beaton, Neurosciences Program, Univ. of Ala. in Birmingham, Birmingham, AL 35294.

Various oxidized pyrroles such as 5-hydroxyhaemopyrrole and kryptopyrrole have been implicated in hepatic porphyria and numerous psychiatric disorders. These compounds have also been shown to have behavior disrupting effects on food deprived rats run on a variable interval schedule of food reinforcement. The dialkylamino derivatives of haemopyrrole were prepared by the acid catalyzed cyclization of chloropyruvic acid and 2-butanone to produce the 3-chloromethyl-4,5-dimethyl-5-hydroxy-2-oxo-2,5-dihydrofuran. This lactone was then treated with either dimethylamine or diethylamine at 0°C in ether to produce the 3-dialkylaminomethyl-4,5-dimethyl-5-hydroxy-2-oxo-2,5-dihydrofuran as a red oil, which was distilled (short path) in *vacuo*. The resulting 3-dialkylaminolactone was then reacted with SOCl_2 at 0°C in a solvent mixture of chloroform and pyridine to produce 3-dialkylaminomethyl-4,5-dimethyl-5-chloro-2-oxo-2,5-dihydrofuran. The 5-chloro lactone was finally converted to the lactam, 3-dialkylaminomethyl-4,5-dimethyl-5-hydroxyhaemopyrrole, by the action of a large excess of liquid ammonia under 80 psi for 24 hours. The chemical kinetics of the formation of intermediates will be discussed as well as the unsuccessful attempts to produce these compounds by acid catalyzed cyclization of dialkylamino-2-keto-propanoic acid and 2-butanone. The structures of all intermediates and products were confirmed by infrared and mass spectroscopy. (Supported in part by the Alabama Consumer Fund.)

THE APPLICATION OF NMR TO PROBLEMS IN INORGANIC CHEMISTRY

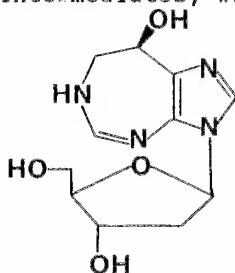
Charles L. Watkins and Gerald S. Vigee, Dept. of Chemistry, Univ. of Alabama in Birmingham, Birmingham, AL 35294.

The general availability of multinuclear Fourier-Transform nmr spectrometers should provide many new opportunities for the understanding of the structure, bonding, stereochemistry, and mechanisms of formation of organometallic complexes. In addition, dynamical and thermodynamic information concerning exchange mechanisms in the coordination spheres of transition-metal complexes can be easily obtained. Two examples will be given. A solvent adduct study of 1,4,8,11-tetraazacyclotetradecane nickel(II) perchlorate with the Lewis bases acetone, N,N-dimethylformamide, methyl sulfoxide, and water is reported. The thermodynamic parameters for adduct formation are given for each solvent system. A chemical dynamics study of substituted 1,3,2-dioxasolanes will demonstrate how the ^1H nmr spectrum is dependent on the stereochemistry of the five-membered ring and its interconversion rate between favored conformers.

STUDIES IN THE BIOSYNTHESIS OF PENTOSTATIN

David C. Baker and Jeff C. Hanvey, Department of Chemistry, The University of Alabama, University (Tuscaloosa), AL 35486.

Pentostatin (covidarabine, Co-V) is an unusual nucleoside that is isolated from Streptomyces antibioticus and is an inhibitor of adenosine deaminase (ADA). Structurally a 2'-deoxy- β -D-erythropentofuranosyl nucleoside having an unique, 1,3-diazepine ring system in the heterocycle, the compound has attracted considerable interest in the fields of cancer chemotherapy because of its unusually potent, tight-binding properties ($K_i = 2.2 \times 10^{-12}$) against ADA. The biosynthesis of the nucleoside is a scientific curiosity, particularly in light of the unusual heterocyclic ring system. The studies described are directed toward elucidating the biochemical pathway to Co-V. Full descriptions of several possible biochemical routes, along with details of the incorporation of radiolabeled intermediates, will be presented.

POTENTIAL TERPENE PRECURSORS FOR RAZDAN SYNTHESIS OF Δ -1-TETRAHYDROCANNABINOL

Robert L. Settine and Jamil Talhouk, Department of Chemistry, University of Alabama in Birmingham, AL 35294.

The Razdan¹ synthesis of Δ -1-tetrahydrocannabinol has become of recent interest due to the use of these type compounds as potential medicinal agents. This laboratory has previously reported² a synthesis of olivitol, which can be envisioned as one half of the starting material for the Razdan procedure. This research effort deals with the synthesis of various terpene precursors, whose common acid catalyzed intermediate make them usable for Δ -1-tetrahydrocannabinol synthesis. Thus, the synthesis of 3-pinene-2-ol, 2-carene-4-ol, and p-mentha-2,8-diene-1-ol are reported using the decomposition of their tosylhydrazones³ as a key intermediate step.

¹ R.K. Razdan, H.C. Dalzell and G.R. Handrich, J. Am. Chem. Soc. 96:5860, 1974.

² S.A. Barker and R.L. Settine, Org. Prep. and Proc. Int. 11:87, 1979.

³ W. Reid and R. Dietrich, Chem. Ber. 94:387, 1961.

SYNTHESIS OF SULFUR ANALOGS OF 3(R),2(S)-3(ADENIN-9-YL)-
2-HYDROXYNONANE

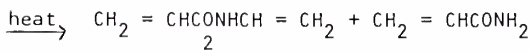
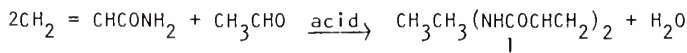
David C. Baker, L. D. Hawkins and J. Farrest Taylor,
Department of Chemistry, The University of Alabama,
University (Tuscaloosa), AL 35486.

Sulfur analogs of the semi-tight binding adenosine deaminase inhibitor (L)-erythro-9-(2-hydroxy-3-nonyl)adenine, wherein the alkyl side-chain is replaced by the SR function, have been synthesized. The project is aimed toward examining the effect of side-chain length, using the allosteric substitution of sulfur for a -CH₂-group, with the idea of developing structure-activity relationships. Carbohydrate precursors, derived from L-rhamnose, were employed for the synthesis of (S)-2-benzyloxypropanal (1). 1 was converted using RSH to the respective dialkyl dithioacetal (2), which was subsequently brominated and coupled to per(TMS)adenine to give the 2-O-benzyl protected acyclic nucleoside. Chemistry carried out to date will be discussed.

Synthesis and NMR of Spectroscopic Study of N-Vinylacrylamide

Chen Chang and Dr. Thomas L. St. Pierre, Chemistry Department, University of Alabama in Birmingham, University Station, Birmingham, Alabama 35294.

N-vinylacrylamide may not be prepared for normal vinylation reactions. It is prepared instead of condensing two moles of acrylamide with one mole of acetaldehyde followed by pyrolysis. Its synthesis can be summarized below:

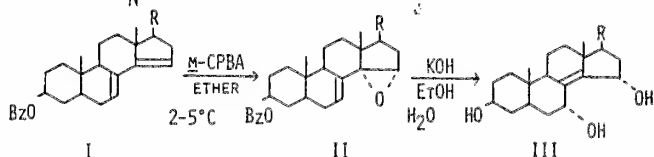


Compound 1 was prepared in good yield at room temperature and was pyrolyzed by kugelrohr apparatus to obtain compound 2. Complete purification could be accomplished by recrystallization from benzene-hexane. The ¹H NMR spectra of the product at 90 MHz and at 300 MHz is consistent with the structure of N-vinylacrylamide. At 300 MHz selected protons were decoupled in order to understand the N-vinyl pattern. The cis/trans amide isomerization complicates one of the N-vinyl peaks.

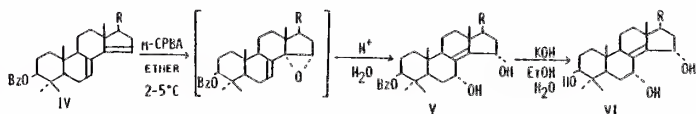
SELECTIVE OXIDATION OF STEROIDAL 7,14-DIENES BY m-CHLOROPERBENZOIC ACID

Edward J. Parish, Dept. of Chemistry, Auburn University, AL 36849

Treatment of 3 β -benzoyloxy-cholest-7,14-diene(I) with m-CPBA under controlled conditions has been shown to produce 3 β -benzoyloxy-14 α ,15 α -epoxy-cholest-7-ene(II) in high yield. Reaction of this product with alcoholic potassium hydroxide yields cholest-8(14)-ene-3 β ,7 α ,15 α -triol(III) by an S_N2^1 ring opening mechanism.



These studies have been extended to the 4,4-dimethyl-7-14-diene system(IV). Treatment of IV with m-CPBA results in the direct formation of diol V, which may be saponified to the known triol VI. Intermediate V is postulated to arise via the acid catalyzed ring opening of a labile 14 α , 15 α -epoxide intermediate similar to the isolated intermediate II.



LEAD SELECTIVE ELECTRODE USE FOR INDUSTRIAL HYGIENE

Thomas Pierce, Dept. of Chemistry, Univ. of North Alabama, Florence, Alabama 35632.

During a ten year period ion-selective electrodes (ISES) have found application to a wide variety of disciplines. Given their portability and apparent simplicity, lead ISES are attractive for Industrial Hygienists concerned with inorganic lead measurement.

This paper compares the advantages and drawbacks of ion specific electrode analysis with the standard atomic absorption procedures for lead.

The findings indicate that even though the ISE should not be relied upon as a primary analytical tool for lead, it may be useful for range finding and independent verification of results obtained in another manner.

Abstracts

PETROLEUM HYDROCARBONS AND PESTICIDES IN WILD LOUISIANA HERON EGGS

Charles D. Duncan, Department of Chemistry, Robert J. Graves and Robert L. Settine GC/MS Center, University of Alabama in Birmingham, Birmingham, AL 35294

Eggs from Louisiana Herons, Hydranassa tricolor, were collected from Cat Island, Alabama, near the mouth of Mobile Bay during April 1978. We report here the development of computer-assisted gas chromatograph/mass spectrometry methodology allowing simultaneous analysis, at parts-per-billion sensitivity, of both pesticide and polychlorinated biphenyl (PCB) compounds with polycyclic aromatic hydrocarbons derived from low-level chronic oil pollution. We also report the analysis of four eggs from this sample, showing the first known accumulation of hydrocarbon contaminants in wild bird eggs. Since the study animal is virtually exclusively piscivorous, we comment on the results as a useful biological monitor of marine pollution.

SYNTHESIS OF METHYL-p-(2-BENZIMIDAZOLYL)METHYLPHENOXY CARBOXYLATE

David C. Baker and Patricia A. Goodson, Department of Chemistry, The University of Alabama, University (Tuscaloosa), AL 35486.

The title compound (I) and its corresponding hydrazide have demonstrated activity against tobacco mosaic virus in vitro. Since viral and cancer activity occur at about the same cellular level, and since many benzimidazole derivatives have been found to exhibit antiviral, antifungal, antibacterial, and antimalarial activities, these two compounds along with two derivatives, N-(p-hydroxybenzylidene)-p-(2-benzimidazolyl)methylphenoxy carboxylic acid hydrazide and N-(2-furfurylidene)-p-(2-benzimidazolyl)methylphenoxy carboxylic acid hydrazide were of interest for possible anticancer activity. The synthesis of these four compounds will be discussed.

AN INFRARED STUDY OF THE REACTION OF DIOXYGEN WITH $\text{MnBr}_2\text{PPhMe}_2$

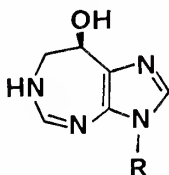
S.D. Worley, W.E. Hill, and V.F. Newberry, Auburn University, Auburn, AL 36849

The complex $\text{MnBr}_2\text{PPhMe}_2$ is reported to react reversibly with dioxygen as a function of pressure. The complex has been prepared as a surface on a KBr window in a vacuum infrared cell by sublimation of MnBr_2 and exposure to phenyldimethylphosphine vapor. The reaction of the complex with dioxygen was followed by infrared spectrometry.

ALKYL DERIVATIVES OF THE PENTOSTATIN AGLYCONE

David C. Baker and Shiv D. Kumar, Department of Chemistry, The University of Alabama, University (Tuscaloosa), AL 35486.

A number of N^3 -alkyl derivatives of the pentostatin aglycone have been synthesized and their adenosine deaminase inhibitory properties studied. The potencies of these alkyl derivatives are significantly lower than either the 3- β -D-ribofuranosyl (coformycin) or the 3- β -D-2-deoxyribofuranosyl (pentostatin) analogs, but these are considerably tighter binding than the free heterocyclic base. Full details of synthesis and enzymology will be discussed.



R=	$K_i \times 10^7 \text{ M.}$
CH ₃ -	73
PhCH ₃ -	84
p-MeOPhCH ₂ -	13
p-ClPhCH ₂ -	6.7
HOCH ₂ CH ₂ OCH ₂ -	7.6
H-	>100

MICROCOMPUTER APPLICATIONS IN UNDERGRADUATE CHEMISTRY

Charles L. Watkins and Larry K. Krannich, Dept. of Chemistry, University of Alabama in Birmingham, Birmingham, AL 35294

The introduction of microcomputer systems has revolutionized experiments in the chemistry laboratory. Microprocessor-based systems can use the experimental data to control an instrument and can be used for real-time data analysis. Microprocessor controlled instruments are common in industrial, clinical, and medical laboratories and graduate programs in which our former students work. We are integrating microcomputer experience into the undergraduate chemistry classrooms and laboratories to prepare our students to be viable practitioners of their discipline in their chosen professions. As a co-recipient of a NSF CAUSE grant, our department has been able to accelerate its efforts in introducing microcomputer systems into the undergraduate curriculum. Students are gaining experience with computer articulated experiments and real-time interactive computing for problem solving skills. We will discuss what is being carried out under NSF CAUSE support, availability of software for microcomputers, and our plans in chemistry. Software will be demonstrated and time will be available for hands-on use of the Apple II+ microcomputer with selected software applications to chemistry.

CELLULOSE HYDROLYSIS IN PHOSPHORIC ACID SOLUTION

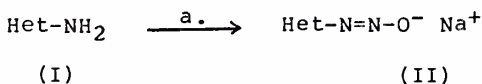
Michael B. Moeller and Raymond E. Isbell, Dept. of Chemistry
Univ. North Alabama, Florence, AL 35632.

Waste cellulosic materials may be converted into fermentable sugars through the hydrolysis of the cellulose polymer. It has been suggested that the substitution of phosphoric acid for the conventional dilute sulfuric acid as the hydrolysis catalyst could improve the economics of the production of ethanol from waste cellulose sources. The expense of the acid would be defrayed by the production of a co-product, dicalcium phosphate, which would be marketed as a fertilizer. We have measured the reaction rates in phosphoric acid solutions and compared the results with rates achieved with dilute sulfuric acid. Phosphoric acid was found to be much inferior to sulfuric acid as the catalytic agent. A solution of 8.0 wt. percent phosphoric acid had the approximate activity of 0.8 wt. percent sulfuric acid. The pertinent reaction kinetics for the acid catalyzed production of glucose from cellulose consist of consecutive, pseudo-first order reactions. The first reaction forms glucose from cellulose and a subsequent reaction decomposes the glucose. Our studies indicate that the glucose decomposition reactions are similar with the two acids but that the mechanism for the cellulose hydrolysis may be different with phosphoric acid than with sulfuric acid. This research has been supported by the Tennessee Valley Authority, Contract No. TV 50532A.

DIAZOHYDROXIDES: REACTIVE INTERMEDIATES AS
ANTICANCER COMPOUNDS

David C. Baker and Carol N. Richmond, Department of Chemistry, The University of Alabama, University (Tuscaloosa), AL 35486.

Diazotization of several aminoheterocyclic compounds (I) under dry, basic conditions has led to the isolation of the corresponding diazohydroxides (II) (see scheme below), which are of interest in cancer chemotherapy. The preparation, isolation and physiochemical characteristics of these compounds will be discussed.

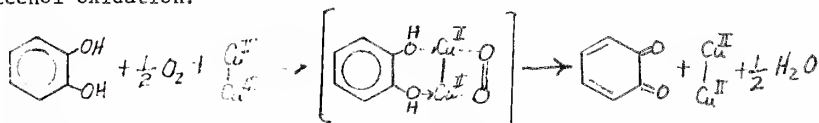


a. i-AmylONO, NaNH₂, THF

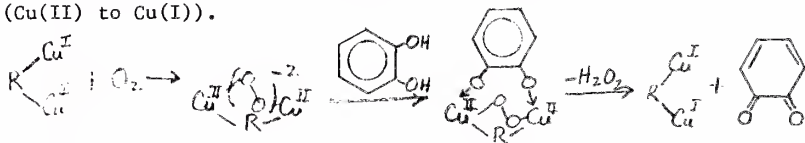
THE CATECHOLASE ACTIVITY OF BINUCLEAR COPPER COMPLEXES

Gerald S. Vige, Dept. of Chemistry, University of Alabama in B'ham, Birmingham, AL 35294

Spin coupled dicopper moieties are found at the active sites of copper enzymes and are used more frequently as catalysts in the oxidative synthesis of new compounds. Both enzymes and industrial type catalysts are used to oxidize catechols with dioxygen but the oxidase mechanism(s) is/are unknown. One proposed mechanism utilizes the dicopper as a site on which the catechol and oxygen come together for catechol oxidation:



This mechanism shows no change in the oxidation state of copper(II) during catalysis. The second mechanism requires a change in copper (Cu(II) to Cu(I)).



By kinetics and electrochemical studies we will test some aspects of the second mechanism

SILICON AND GERMANIUM ESTERS AND THEIR REACTION WITH GRIGNARD REAGENTS

McDonald Moore, Sr., Deborah A. Colvin, and Edwina McMillian. Department of Chemistry, S. D. Bishop State Junior College, Mobile, Alabama 36690

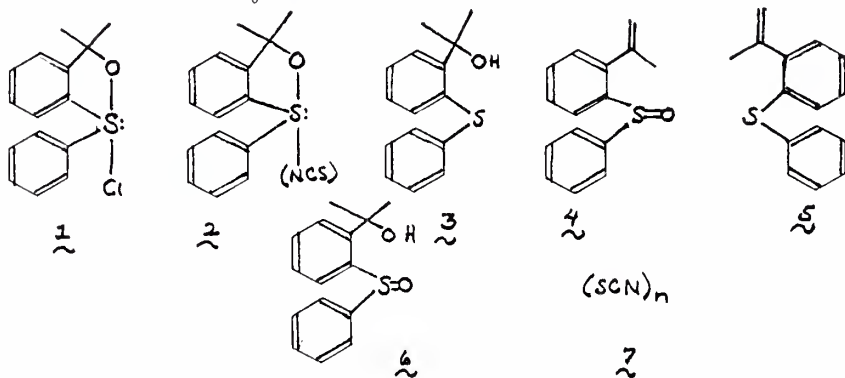
This report describes the synthesis and properties of three new silicon esters. Hexapropionyxydisiloxane and hexabenzoxydisiloxane have been prepared from hexachloro-disiloxane and the sodium salts of the organic acids. Disibacoxysilane has also been prepared from tetrachloro-silane and anhydrous sodium sebacate. These silicon esters react with water, alcohol, and ammonia. They decompose when heated. Ether solution of hexapropionyxydisiloxane reacts with phenylmagnesium bromide to produce propiophenone, ethyldiphenylcarbinol, and a silicone. Tetrabutyroxygermane also reacts with benzylmagnesium bromide to form tetrabenzylgermanium and bis (tribenzyl-germanium) oxide.

Abstracts

CROWN ETHER MEDIATED REACTION OF THIOCYANATE WITH A CHLOROSULFURANE

M. Eggers and P. Livant. Department of Chemistry, Auburn University, Alabama 36849

The reaction of thiocyanate ion and catalyzed by 18-crown-6 with chlorosulfurane 1 in CH_2Cl_2 was explored as a route to thiocyanato- (on isothiocyanato) sulfurane 2. The reaction proved to be complex, products 3, 4, 5, and 6 being identified by comparison with authentic samples, while 7 was identified by microanalysis. At certain levels of 18-crown-6, NMR evidence of sulfurane 2 was obtained. However, 2 has not yet been isolated. Studies directed at elucidating a mechanism for the reaction of 1 with SCN^- will be discussed.



SYNTHESIS OF EHNA AND ITS ISOMERS FROM CHIRAL PRECURSORS

David C. Baker and L. D. Hawkins. Dept. of Chemistry, Univ. of Alabama, University, AL 35486

The synthesis of both isomers of EHNA ("erythrohydroxynonyladenine") from D- and L-rhamnose is described. The key intermediate (R)- and (S)-2-benzoyloxypropanal, derived respectively from 5-O-benzyl-D- and L-rhamintol, was condensed with hexylmagnesium bromide to give a 3:1 mixture of threo: erythro alcohols. Conversion of the threo alcohols to their mesylates, displacement of the latter with adenylyl sodium, followed by debenzoylation, afforded the desired erythro species in both series. The 2(S), 3(R)-3-(adenin-9-yl)-2-nonyl isomer ("L-EHNA") was found >80-fold more tightly bound to adenosine deaminase ($K_i = 7.64 \times 10^{-10}$ M.) than its 2(R), 3(S)-isomer ($K_i = 6.23 \times 10^{-8}$ M.). In addition, the erythro alcohols were converted to the threo derivatives, the 2(S), 3(S)- and 2(R), 3(R)- isomers, by an identical set of reactions.

NEW AND NOVEL HETEROCYCLES RELATED TO THE
PENTOSTATIN AGLYCONE

David C. Baker and L. D. Hawkins, Department of Chemistry,
The University of Alabama, University (Tuscaloosa), AL
35486.

The syntheses of analogs of the potent adenosine
deaminase inhibitor pentostatin, (R)-3-(2-deoxy- β -D-erythro-
pentofuranosyl-3,6,7,8-tetrahydroimidazo[4,5-
d][1,3]diazepin-8-ol, are being carried out in these
laboratories. The synthetic approaches toward 6-hetero-
4,5,6,7-benzimidazoles using methyl 1-benzyl-2-
mercaptoimidazo carboxylate as the starting material are to
be discussed.

A NEW ACYCLIC NUCLEOSIDE:

2(S),3(R)-1-(ADENIN-9-YL)-2,3,5-TRIHIDROXYPENTANE

David C. Baker and Thomas U. Carr II, Department of
Chemistry, The University of Alabama, University
(Tuscaloosa), AL 35486.

A stereospecific synthesis of 2(S),3(R)-1-(Adenin-9-yl)-
2,3,5-trihydroxypentane (I) from L-arabinose is described.
The key intermediate 2-deoxy-L-erythro-pentose diethyl
dithioacetal (II) was prepared by a route involving the
formation and reduction of a ketene dithioacetal. Selective
tosylation of II, followed by acylation, and adeninylation
using adenin-9-yl sodium gave the desired, protected acyclic
sugar nucleoside (III). Subsequent deacylation, demercap-
tation and borohydride reduction of III gave the title
compound. Full details of the synthesis will be presented.

SOLUTION PROPERTIES OF MOLYBDENUM(II) THIOACETATE AND DITHIOACETATE

Thomas R. Webb, Austin H. Reid, and Billy P. Bradford, Department of
Chemistry, Auburn University, AL 36849

The binuclear molybdenum(II) thioacetate and dithioacetate complexes
form axial adducts with a number of Lewis bases. Spectroscopic studies
indicate that the axial binding is rather weak. The thioacetate exists
in solution as a mixture of isomers. The isomers interconvert on the
nmr time scale at higher temperature; a 1,2-shift is proposed as the
mechanism.

Abstracts

3-DEAZACORDYCEPIN: A CHEMICAL APPROACH

David C. Baker, F. Leslie Boyd and L.D. Hawkins, Department of Chemistry, The University of Alabama, University (Tuscaloosa), AL 35486.

An approach to the title nucleoside involves the following: (1) the synthesis of 4,6 -dichloroimidazo[4,5-c]pyridine (I) according to the procedure of Rousseau and Robins [J. Het. Chem. 2, 196 (1965)]; (2) the synthesis of 1,2-di-O-acetyl-5-O-benzoyl-3-deoxy-D-erythropentose (II) by a modification of the procedure of Nair and Sinhababu [J. Org. Chem. 43, 5013(1978)]; (3) a nucleoside coupling reaction between trimethylsilylated I and II using tin(IV) chloride as a Lewis acid catalyst. Details of these reactions will be discussed.

SYNTHESIS AND ANTIVIRAL ACTIVITY OF SOME 5'-C-ACETIC ACID DERIVATIVES OF ARA-A

David C. Baker and Richard P. Crews, Department of Chemistry, The University of Alabama, University (Tuscaloosa), AL 35486.

The synthesis of 1-(adenin-9-yl)-1,5,6-trideoxy- β -D-arabinohepto-1,4-furanose, 1-(adenin-9-yl)-1,5,6-trideoxy- β -D-arabinohepto-1,4-furanuronamide and related compounds from N-benzoyl-9-(2,3-di-O-benzoyl- β -D-arabinofuranosyl)adenine is reported. Similar syntheses using other nucleosides as precursors have resulted in biologically active products. This work represents the first reporting of antiviral activity for this group of compounds. Details of the chemistry will be presented.

DI-TERT-BUTYLDIMETHYLSILYL DERIVATIVES OF ARA-A

David C. Baker and Richard P. Crews, Department of Chemistry, The University of Alabama, University (Tuscaloosa), AL 35486.

9-(2,3-Di-O-tert-butyldimethylsilyl- β -D-arabinofuranosyl)adenine (1) is a useful compound for the specific derivitization of the 5'-position of 9- β -D-arabinofuranosyladenine. Synthesis of (1) and other, related derivatives of ara-A, including the 2',5'-di-O-, 3',5'-di-O- and 2',3',5'-tri-O-TBDMS compounds, further demonstrate the potential of tert-butyldimethylchlorosilane in specific protection of nucleosides. Details of the chemistry will be presented.

BIVALVES AS INDICATORS OF ENVIRONMENTAL POLLUTION

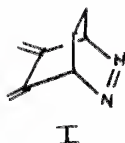
Robert L. Settine, Robert J. Graves and Ken Marion, University of Alabama in Birmingham, Birmingham, AL 35294.

A simple and sensitive procedure was developed for determining aliphatic and aromatic hydrocarbons, EPA priority pollutants, PCB's and organochlorine pesticides. The procedure involves cellular disruption, extraction, column chromatography, and fused silica capillary column GC/MS analysis. The method is applicable to a wide variety of organisms and allows the identification of the above mentioned contaminants with one GC injection. Using this method, Mobile Bay oysters (Crassostrea virginica) have shown compounds from all five groups listed.

SECOND ORDER KINETICS FROM A BICYCLIC AZO COMPOUND

Charles D. Duncan, Department of Chemistry, University of Alabama in Birmingham, Birmingham, AL 35294

The synthesis of bicyclic azo compound, I, reported to yield a cyclic tetramethyleneethane biradical is described, as is a convenient method for monitoring its reaction kinetics. At 0.13 M concentration, unlike most azo or diazo compounds, its reactions are not unimolecular. Decomposition rates at 100.20°C show second order kinetics, and half-life is dependent on initial azo concentration. A mechanism for this second order process is considered.



GEOLOGY

GEOLOGICAL INTERPRETATION AIDS ARCHAEOLOGICAL SITE LOCATION

Philip Stroud. Dept. of Geology and Norman Bayne Cranford, Auburn University, Auburn, AL 36849.

Wilcox County is in the Gulf Coastal Plain. The Northern tenth, about 90 square miles, is within the outcrop area of Cretaceous formations and the southern nine-tenths is within the outcrop area of Tertiary formations. Quaternary flood-plain and terrace deposits border the Alabama River and its larger tributaries. The archaeological site being investigated is within the Alluvial deposit area of the Alabama River Quaternary flood-plain, and rock types consist of angular to rounded quartz, cherts and quartzite gravel. Sedimentological research, grain analysis study, is continuing in the area in an attempt to locate ancient river meanders. There appears to be a connection between ancient river meanders and sites of early indian habitation.

Abstracts

ANALYTICAL METHODS FOR RAPID DETERMINATION OF BEHAVIOR OF ELEMENTS IN ELECTRIC UTILITY SOLID WASTES DURING LEACHING

Jim Redwine, Southern Company Services, Inc., Birmingham, AL 35203

Coal-fired boilers use more than 500 million tons of coal per year. This produces enormous quantities of fly ash. Utility companies must dispose of the ash. Very little is known about the behavior of fly ash when exposed to weathering. Laboratory leaching in a Soxhlet extractor gives an easy and rapid, though not necessarily chemically rigorous, means of predicting the behavior of elements during the leaching of fly ash. Known parameters in such experiments include (1) major, minor and trace element composition of the ash; (2) quantity of ash; (3) composition of the leaching agent, especially pH; (4) temperature and (5) leaching time. A log-log plot of concentration in a leachate versus time leached, known as a CVTL curve, provides data on how an element behaves during leaching, and the element's distribution and bonding within ash particles. A straight-line curve with constant positive slope points to leaching ideality, that is, uniform distribution of a particular element within a sample, solubility within a particular leaching agent, and lack of secondary reactions between the elements being leached. Departure from ideal conditions causes departure from the ideal straight line curve. Since the CVTL curve measures rate, factors which affect rate of removal of an element during Soxhlet extraction changes the slope of this curve. These leaching experiments indicate the amount of a particular element in a leachate depends upon the amount of the element and its mode of bonding in the ash, the element's solubility in the leaching agents, duration of leaching, and the element's involvement in secondary reactions.

CHITINOZOANS IN THE FROG MOUNTAIN SANDSTONE

John E. Sebastian, Dept. of Geology, Auburn Univ., Auburn, AL 36849

Chitinozoans are reported for the first time in the Frog Mountain sandstone. The rock samples from which the chitinozoans were obtained were collected near the base of the Frog Mountain exposure in the Red Mountain expressway cut at Birmingham, Alabama. The rock samples were acidified in HCl and HF. The chitinozoans were concentrated from the residues by flotation in zinc chloride and mounted on glass slides for examination. Three genera and seven species of chitinozoans, *Angochitina devonica*, *Angochitina globosa*, *Angochitina sinica*, *Angochitina milanensis*, *Angochitina mourai*, *Ancyrochitina spinosa*, *Lagenochitina crassa* have been identified. Five species, *Angochitina globosa*, *Angochitina sinica*, *Angochitina milanensis*, *Angochitina mourai*, *Lagenochitina crassa*, are only known from Devonian age rocks. *Angochitina sinica* has only been previously reported from Devonian age rocks in China. *Ancyrochitina spinosa* and *Angochitina devonica* have been reported from late Silurian and Devonian rocks. The occurrence of these microfossils indicates that the Frog Mountain sandstone at Birmingham is middle Devonian in age.

Abstracts

THE WINSTON CAVE LOCAL FAUNA AND THE LATE PLEISTOCENE FAUNAL GRADIENT IN EASTERN NORTH AMERICA

Daniel R. Womochel, Dept. of Geology, Auburn Univ., Auburn, AL 36849

A Pleistocene mega- and micro-vertebrate fossil fauna of late Wisconsin age has been quarried from Winston Cave near Tuscumbia, Colbert County, in northern Alabama. Eighteen species of mammals, including five species of bats, have been identified from the cave. All genera and species are extant and still live in the area except *Equus* sp. and *Mylohyus* sp. The fossils are preserved in debris that filled a deep sinkhole. Erosion and cave expansion have undercut the sinkhole fill and exposed the fossils in the ceiling of the cave. The cave is situated on the boundary between the Appalachian Valley and Ridge Province and the Gulf Coastal Plain and the associated boundary between the Austroriparian and Carolinian biotic provinces. These boundaries are important transitional zones between modern mammalian faunal assemblages in the southeastern United States. Comparison of the Winston Cave fauna with other late Pleistocene cave faunas from this region and from further north in the Valley and Ridge provides a unique opportunity to assess the occurrence and significance of a late Pleistocene and postglacial change in the mammalian faunal composition and distribution in this area. Preliminary studies indicate that the mammal fauna of this area was either not influenced significantly by the Wisconsin glaciation or that the mammal fauna of this region attained a modern distribution and composition by late Wisconsin time.

A PRELIMINARY STUDY OF THE INVERTEBRATE MEGAFAUNA ASSOCIATED WITH THE UPPER CLIFF COALS (EARLY PENNSYLVANIAN), PLATEAU COAL FIELD, NORTHERN ALABAMA

Michael A. Gibson, Dept. of Geology, Auburn University, Auburn, AL 36849.

Abundant invertebrate fossil assemblages associated with the Upper Cliff Coals in the Early Pennsylvanian Pottsville Formation have been located between Oneonta and Guntersville in Blount, Marshall and Jackson counties, Alabama. The fossil assemblages include fenestrate bryozoans, *Pentrimites*, blastoids, and columnal debris associated with a bioherm structure in southern Jackson County. This exposure has been interpreted to represent a distal bar facies. Exposures near Tatter's Knob and Berry Mountain, Blount County are dominated by productid brachiopods, pinnaceans, pectinaceans, and abundant trace fossils. *Zoophycus* is one of the most abundant genera of trace fossils encountered in these deposits. Many of the invertebrate fossils are preserved in living position. These deposits have been interpreted as interdistributary bayfill facies. The fossils and sediments indicate a marine to brackish water environment deposition.

Abstracts

PRELIMINARY INVESTIGATION OF TRACE ELEMENTS IN LOWER PALEOZOIC CARBONATES OF THE SOUTHERN APPALACHIAN VALLEY AND RIDGE PROVINCE

Christopher John Crow, Dept. of Geology, University of Alabama in Birmingham, Birmingham, AL 35203

Various structural and age interpretations have been applied to the dolostone, quartzite and chert terrains in the eastern Valley and Ridge province adjacent to the Talladega Front in Talladega, Cleburne and Cherokee Counties, Alabama. Ages ranging from Cambrian to Mississippian have been assigned to these terrains. Local fossil occurrences in some of these terrains demonstrate that some are of Lower Cambrian, Weisner and Shady, age. The purpose of this study is to correlate the trace element composition of some of these unfossiliferous carbonate terrains of uncertain age with those from carbonate terrains of known age containing fossils in this region of Alabama. The analytical method used is atomic absorption spectrophotometry. Samples from known carbonate units are prepared according to standard techniques. Replicate analysis of samples indicates a variance as great as 50% in iron and strontium. Average variance is found to be on the order of 25%. The variability is extreme and, at present, it appears to result from a lack of sample homogeneity. More sampling will be required in the units of known age, both within individual beds and across intervals involving several beds, to determine if observed ranges of trace element concentrations in these formations are consistent enough for comparison with formations of unknown age.

LOCATION OF THE KYANITE-SILLIMANITE ISOGRAD IN THE TALLASSEE SYNFORM, DADEVILLE COMPLEX, ALABAMA

Ian A. Walls and Michael J. Neilson, Dept. of Geology, The University of Alabama in Birmingham, Birmingham, AL 35294

Within the Tallassee Synform, the widespread and definitive prograde regional metamorphic assemblage in the Agricola Formation is kyanite-biotite-garnet-muscovite-plagioclase-quartz. Staurolite is absent. Based on work to date, the kyanite-sillimanite isograd (mapped on the first appearance of sillimanite in kyanite-bearing rocks) has an irregular and discontinuous pattern. North of Doss Mountain, the isograd appears to be folded by an F_1 (isoclinal) fold; but a relationship between the distribution of sillimanite-bearing rocks and the traces of fold axes of any generation is not evident in other areas. Textural analysis indicates that metamorphism was broadly synchronous with the first recognizable deformation event. It is suggested that these rocks were subjected to T/P conditions within the kyanite stability field and that the irregular distribution of sillimanite-bearing rocks represents minor perturbations in the T/P regime. Conditions of metamorphism are estimated to have been at least 680°C and 7Kb.

STRATIGRAPHIC BREAKS AND VERTICAL CONTINUITY

David T. King, Jr., Dept. of Geology, Auburn University, AL 36849.

A stratigraphic break is an interruption in the completeness of the stratigraphic record. Stratigraphic breaks have a manifest presence in the stratigraphic record--indeed there are far more gaps than time-record. Stratigraphic breaks may be significant or insignificant with respect to time-record lost. Significant breaks, reflecting changes in environmental and/or tectonic regimen, are unconformities (nonconformities, angular unconformities, disconformities, or paraconformities). Insignificant breaks, reflecting changes in environmental stage, are diastems (surfaces of erosion, scour, or non-deposition). Breaks may be recognized on physical, paleontological, and/or structural criteria. However, their significance is assessed on the basis of paleontological criteria, especially disconformities and paraconformities. In too many cases faulty or improperly applied paleontological criteria are used to ascribe significance to breaks that are diastems. In this way disconformities and paraconformities are described in stratigraphic sequences that otherwise display vertical continuity according to Walther's Law, Uniformitarianism, and the Rule of Simplicity. This vertical continuity should be a prime consideration in evaluating the significance of stratigraphic breaks.

AN ANALYSIS OF THE STRUCTURAL FABRICS OF THE ROCKMART SLATE

David M. Sibley, Dept. of Geology, Auburn Univ., Auburn, AL 36849.

The Ordovician Newala, Lenoir, and Rockmart Formations near Rockmart, Georgia are situated in a reentrant of the Valley and Ridge Province into the Talladega Metamorphic Front. In this area these formations have a penetrative tectonite fabric. Analysis of bedding, bedding fold axes, cleavage, bedding-cleavage intersections, boudin axes, slate pencils, crenulation cleavage, crenulation lineations, and pebble lineations indicates the study area is divided into three fabric domains. In all domains bedding fold axes and bedding-cleavage intersections define a great circle, the pole of which plunges steeply to the northwest. The cleavage is approximately parallel to trend of the Talladega Front and is gently folded about an axis with a shallow eastward plunge. One set of crenulation lineations and pebble lineations are parallel to this axis.

A sandstone lithologically similar to the Devonian Frog Mountain Sandstone, overlies the Rockmart Slate with angular unconformity and does not possess a cleavage. At one location, Rockmart Slate is absent and uncleaved Frog Mountain Sandstone lies directly above Newala.

Abstracts

FORESTRY, GEOGRAPHY, CONSERVATION, AND PLANNING

A GEOGRAPHIC APPROACH TO RETIREMENT

Wilbur B. DeVall, President, Proxy Services Ltd., Auburn, AL 36830

Older people progress from the 3 R's of youth - 'readin', 'writin', and 'rithmetic to the 3 R's of old age - reminiscin', recallin', and rememberin'. The approach to retirement should be geared to a geographic base. While active, one should acquire information, mementos, and other reminders of countries, states, and local scenes which can then become the basis for reminiscing when confinement arrives during later years. The years spent in retirement must relate back to houses in which one lived, the streets and scenes which surrounded these houses, and the towns, states, and countries in which these places of abode occurred. The farther away from one's birthplace one enters retirement the more meaningful will be these geographic references. The country most remembered will be the one in which born. It could also be one visited as a tourist or military person. After leaving a country or countries, reflections normally involve the language of the location, the monetary system, local customs, and places and buildings of interest. The symbols taken into retirement vary with the person and his background. Those most common include post cards, picture prints or slides, souvenirs, currency, brochures and leaflets, and books. The geographic approach to retirement can make the expectations of old age and confinement pleasant. Enjoyment of retirement comes from staying busy, recalling people met in the more active years and those with whom travel may have been a shared experience as well as the little incidents which occurred and are remembered in the mind or when viewing pictures and other materials.

PUBLIC LAND LAWS AND SETTLEMENT OF THE MOUNTAINS OF NORTHEAST ALABAMA

Merilyn Osterlund. Department of Geography, University of Tennessee, Knoxville, TN 37920

Alabama was a public domain state and as land was opened for sale the more desirable agricultural land was quickly purchased; the less desirable mountain land was gradually alienated under the Graduation, Homestead, and Timber and Stone Acts. As recently as 1957, in northeast Alabama, there were tracts of unclaimed public land. In the rugged and isolated mountain areas are numerous abandoned homesites and only two occupied sites. The homes that occupied the abandoned sites were built to meet the requirements of alienating land under the Homestead Act. Currently at least 60% of the mountain land is owned by out-of-state corporations.

ALABAMA'S 1982 LEGISLATIVE FORESTRY STUDY COMMITTEE REPORT

Wilbur B. DeVall, President, Proxy Services, Ltd., Auburn, AL 36830

Five reports of Alabama's Legislative Forestry Study Committee have been submitted to the State's legislative body. Currently operating under Act No. 79-711, with a membership of fifteen, as defined in the Act, the Committee emphasizes land productivity, both for agriculture and forestry, wood residue utilization from logging operations and wood-using industries, use of prescribed fire to improve woodlands, getting non-managing landowners together to discuss their needs, establishment of a school of forestry at Auburn University, improving stewardship of lands owned by State agencies, and power generation for sale to utilities from wood-based industries. The Committee has accomplished several goals and these are reported on in the 1982 report. Recent budget increases for the Forestry Commission have permitted phasing in a system of aerial detection of wildfires in the Commission's ten Districts. The results of seven meetings held over the State in 1981 were reported to the Governor in the area of improving and increasing productivity of forest lands. Periodic studies in Alabama have revealed that the forest industry has grown since 1960 at a compound interest rate of nearly 12%. The Southern Solar Energy Center has funded five feasibility studies for potential wood energy installations. Legislation has been drafted which, if passed, would encourage improved fire protection, use of prescribed fire, and increased forest productivity. One new nursery site near Thorsby came into possession of the Forestry Commission as a result of the Committee's definition of this need. Other legislation is being developed which would enable the Legislative Fiscal Office, which maintains records on state-owned lands, to improve its system and make records available to state agencies having access to computer terminals.

RELEVANCE OF PREDICTIVE MODELS TO HISTORIC
SITE ANALYSIS IN THE T.M.R.D.

David C. Weaver, Dept. of Geography, University of Ala., University, AL 35486

In 1978 The U. S. Army Corps of Engineers funded a study of the regional character of cultural resources in the vicinity of the Tennessee Tombigbee Waterway. One of the most important of the objectives of the Research Design was the structuring of analyses of the settlement system to test a variety of settlement models proposed by social scientists. It was anticipated that formulating and testing such settlement and economic models could produce a framework for evaluating the significance of the archeological sites, and a foundation for systematically selecting sites for extensive excavation as well as providing data for references on the operation of the social and political systems within the region. A number of models were selected for study in terms of their potential utility to mitigation activities. They included a) models of cultural diffusion b) models of ethnic settlement forms c) models of type of settlement structures and d) models of relative location. The results of testing these models are discussed.

Abstracts

ALTERNATIVE METHODS OF MUNICIPAL SOLID WASTE DISPOSAL

Noland C. Williams, Regional Planner, TVA, Nashville, TN 37203
Richard Holst, Planner, NW Ala. Council of Local Gov't., Sheffield, AL 35660

Cities and towns are increasingly recognizing the need for alternative methods of solid waste disposal. Landfilling, the most traditional method, is now viewed as an inappropriate method of doing away with municipal waste. Not only are operational costs increasing rapidly, but land acquisition costs are rising. Capital equipment, compactor trucks and bulldozers, are more costly and will be more in future years. Diesel fuel and gasoline will rise to unknown levels and are already straining the budgets of many municipalities. Land suitable for landfills in metropolitan areas is scarce and expensive. More importantly, citizens and public officials alike are beginning to realize that landfills are not a wise use of a limited natural resource--land. In addition to being a poor land use, landfills contribute to water pollution, through chemicals leaching into groundwater, and increasing air pollution from improper operating incinerators. As technology becomes more widespread, we are learning that much of the solid waste stream can be reused to generate income and energy. This is vital to municipalities, especially in light of the policies of the present administration. For these, and other reasons, resource recovery is being closely examined by many cities and towns. In addition to prolonging the life of existing landfills, resource recovery offers other benefits as well. Some are: positive environmental effects, potential for competitively priced stable energy production, which is attractive to industries, decreased waste disposal costs, reuse of materials, and creation of new jobs.

ISSUES OF WASTE CONVERSION TO ENERGY

Wayne R. Glass. Solid Waste Disposal Authority of the City of Opelika, Opelika, AL 36802

Many technologies exist for the conversion of wastes to usable forms of energy, but political, economic and institutional issues hinder the utilization of such technologies. The effect of these issues is particularly apparent in the development of projects using municipal solid waste to produce energy, which serves to offset the cost of disposal. While the Southeast has generally been slower than other areas of the country in the development of these types of projects, several areas in Alabama have concentrated efforts on the conversion of solid waste to energy. An examination of several projects within Alabama reveals problems which impede rapid and smooth implementation of waste-to-energy technologies, such as developing financing for multi-million dollar facilities, public or political opposition and securing long term contracts for waste supply and energy sales. Lessons learned from existing or past projects can help other planners avoid or overcome similar problems.

THROUGH THE CORRIDORS OF THE PLEISTOCENE WITH HOMO ERECTUS

Mary Katherine McInnish and Andrea Priscilla Holland. Department of Geography, University of North Alabama, Florence, AL 35632-0001.

During the Pleistocene glacial epoch, Homo erectus embarked upon a tremendous and incredible journey. His migrations began in his East African homeland. Those migrations covered a millennia, and involved thousands of miles.

Despite harsh climatic conditions, despite the rigors of existence in new and sometimes adverse environments, erectus adapted to different environmental habitats, developed new tools, and diffused his characteristic culture as he traveled.

Erectus became spatially and temporally dispersed over vast and differentiated geographical regions upon the completion of his tremendous and incredible journey. Erectus had explored and settled much of the Old World.

PHYSICS AND MATHEMATICS

FORMATION OF ARMS IN SPIRAL GALAXIES: NEW EVIDENCE FOR A GRAVITATIONAL MECHANISM

Gene G. Byrd, Dept. of Physics and Astronomy, University of Alabama
University, AL 35486

Spiral galaxies show several varieties of arm patterns in their disks. Some show two main arms coming out from the nucleus. Others have a more chaotic pattern of many shorter arms. Galaxies that have two main arms can also have shorter arms or spurs branching off the main arms. The two-arm patterns are generally accepted to be a gravitational density wave traveling around the nucleus. Two mechanisms have been put forward to explain the shorter arms or spurs in both the chaotic and two-armed spirals. First, the spurs are expanding fronts of star formation caused by supervovae. These fronts themselves subsequently have supernovae etc. and are stretched into arms by orbital motion in the galaxy disk. In the second explanation, the short arms are localized gravitational disturbances caused by orbiting lumps of gas and stars in the disk. Previous work on the morphology of the spurs has not been able to show which of these two mechanisms is correct. Using computer models, we have studied a spur in the nearest large spiral galaxy, M31, for which not only are morphological observations available but also 21 cm radial velocity data over the disk. Comparison of the computer model results with the radial velocity and morphology data shows that this spur is a gravitational disturbance caused by a large cloud of gas and stars, NGC 206, in M31's disk. Presumably other galaxies' spurs are caused in the same way.

Abstracts

APPLICATION OF RESEARCH ON TEACHING-LEARNING TO TEACHING INTRODUCTORY PHYSICS

Robert P. Bauman, Dept. of Physics, University of Alabama in Birmingham, Birmingham, Alabama 35294

Innovations in teaching have been plentiful, but usually based on a trial and error approach, on a behaviorist model, or centered around the curricular materials. Only within the last decade has there been a substantial exploration of the student and the mental processes of the student, in contrast to the logical arguments of the instructor. Results have been surprising and are now beginning to yield valuable information relevant to classroom teaching, especially in physics. Reproducible results from many investigators have shown a majority of college students are incapable of grasping the concepts that we consider fundamental to understanding introductory physics. Less plentiful but still impressive research results have shown that students can be changed, with proper techniques, so that they can comprehend the logic of science and mathematics. It has also been shown by several studies that conventional courses do little or nothing to accomplish this important goal. In fact, conventional courses require the typical student to acquire bad habits in order to pass, thus adding to the students' difficulties. Effective techniques include practice in pure problem solving on carefully structured examples, confrontation with logical difficulties in the context of very elementary subject matter, and especially the establishment of an active role for the student learner, in contrast to the conventional passive role of reading, listening, and repeating.

ANALYSIS OF IMAGE SMEAR IN CRT DISPLAYS

Clarence E. Rash and Jacob Becher*, US Army Aeromedical Research Laboratory, Fort Rucker, AL 36362

The increase in the use of cathode-ray-tube (CRT) displays for target detection and recognition has placed an emphasis on the ability of these displays to accurately reproduce amplitude and phase information for dynamic targets. This analysis investigates the theoretical dynamic image degradation occurring at the display as a result of the interaction between the target/sensor relative velocity, the CRT system scan rate, and the persistence of the display phosphor. Expressions are developed to allow comparison of phosphors on the basis of modulation loss due to target/sensor motion. A model is developed which equates a target having a spatial frequency (S) and moving with a horizontal speed (V) to a stationary target with a sinusoidal varying intensity of frequency, f_t , equal to SV . The model verifies phosphor persistence as a major contributor to amplitude modulation loss and predicts several image artifacts such as "freezing" and apparent motion reversal.

DISCLAIMER:

The views of the authors do not purport to reflect the positions of the Department of Defense. (Para. 4-3, AR 360-5)

FLUORESCENCE STUDIES OF MYOSIN SUBFRAGMENT-1

Robert C. Walton and Herbert C. Cheung*. Dept. of Biomathematics, Univ. of Ala. in B'ham, B'ham, AL 35294

Myosin ATPase is an energy transducing enzyme which is involved in the contractile mechanism. Nucleotide binding is known to induce structural changes at the active site. We have studied such changes which involve tryptophanyl residues located within the active proteolytic fragment, subfragment-1 (S-1). Fluorescence spectroscopy was used to investigate these residues and their accessibility to collisional quenching by KI. The Stern-Volmer plot displays a downward curvature indicating the presence of at least two populations of residues. The quenching results allowed us to construct the emission spectra of the quenched and unquenched residues. The emission maximum of the unquenched protein, the exposed residues, and the buried residues was 344, 350, and 335 nm respectively. The quantum yield of the exposed residues was 46% as compared to the unquenched protein, while the buried residues exhibited a quantum yield approximately 160-220% of that displayed by the unquenched protein. MgADP reduced the quenching by KI and blue-shifted the emission maximum by 4 nm, but had no effect on the emission maximum of the two populations of residues. These results are in agreement with the contention that nucleotide binding shifts the distribution of the two populations of residues toward a more overall non-polar environment.

COMPUTER MODELING OF ELECTRICAL DISCHARGES

Robert P. Bauman. Dept. of Physics, University of Alabama in Birmingham, Birmingham, Alabama 35294

Increasing attention to radiofrequency discharges, for etching surfaces, reaction of molecules, and deposition from plasma, has emphasized the lack of a good model for the discharge itself. Starting with procedures previously applied by Phelps and coworkers to study time-dependent phenomena in dc discharges, a program has been written to look at the time and space dependence of electrons, ions, and field parameters in rf discharges. Local field approximations give an equation for electrons and a similar equation for ions expressing time variation in terms of sources, sinks, and flux. This is combined with Poisson's equation for potential. Symmetrical boundary conditions are achieved with Milne's equation, setting macroscopic flux at the boundary equal to the kinetic theory expression for flux. An external resistance and natural tube capacitance are included. Empirical parameters for the gas properties are employed. The solution technique is Crank-Nicholson, time-centered implicit method with predictor-corrector step. The program allows for a variable spatial grid to increase detail in regions of maximum interest. The solution step is by matrix inversion of a tridiagonal matrix.

Abstracts

A PARADOX OF CORIOLIS ACCELERATION OF FALLING BODIES

Robert P. Bauman, Dept. of Physics, University of Alabama in Birmingham, Birmingham, Alabama 35294.

The Coriolis force is often a difficult concept for students to grasp. Like the centrifugal force it is fictitious, but as usually presented it is less easily observed directly. Simplified models, such as merry-go-rounds and spinning dancers, can be helpful. A particularly simple example is the tall flag pole, at the equator, from which a ball is dropped. Because the top of the pole is moving faster than the base, the ball is expected to fall in front of the base (to the east), and the distance is easily found in terms of the difference in speed and the time of fall. However, the answer disagrees with other methods of calculating the same quantity, and is, in fact, 50% greater than the answer obtained by conservation of angular momentum or by direct double integration of the Coriolis acceleration. The answer lies in the direction of the gravitational field (radial, not necessarily parallel to the initial vertical axis) and the nature of the trajectory. This is one of the few instances in which the difference between elliptical and parabolic trajectories has a major effect for objects close to the surface of the earth.

USING AN APPLE COMPUTER WITH AN ESR SPECTROMETER

Clint Carlisle and Chester Alexander. Dept. of Physics and Astronomy, Univ. of Ala., University, AL 36486

We have recently acquired an Apple Computer for use in an ESR/ENDOR research lab, and this talk will describe some of our initial uses of this computer with the spectrometer. In particular, the computer is used, through an RS-232 interface, with a signal averager. First and second derivative ESR spectra can be plotted with high resolution graphics and the data can be analyzed in many ways with appropriate programs. Examples of kinetic data will be demonstrated with the computer.

PLASMA ELECTRON HEATING BY TEST ELECTRONS

M. D. Haworth and R. E. Kribel, Dept. of Physics, Auburn University, AL 36849

Initial results are given for plasma electron heating by isotropically injected monoenergetic test electrons in a DC multidipole plasma device. The experimental arrangement is described, along with the conditions under which electron-electron Coulomb collisions alone need to be considered.

VACUUM HIGH PRECISION LASER INTERFEROMETER MEASUREMENTS OF LOW CTE QUARTZ AND GRAPHITE EPOXY

C. J. Rives,* D. A. Gregory,* and J. H. Davis, Physics Depart., Univ. of Ala., Huntsville, AL 35899. J. G. Castle,* Sandia Labs, Albuquerque, NM 87185.

A system for measuring the expansion of low coefficient of thermal expansion (CTE) materials has been constructed about a H.P. 5526-A laser measuring system. The vacuum ($\sim 1\mu$) CTE measurements in the -150°F to $+120^{\circ}\text{F}$ range were made over a 6 month period on a 2.3" O.D. x 1/16" wall by $\sim .9$ m long 59° wrap graphite epoxy (G/E) tube yielding CTE (α) values of 2.5 to $5 \times 10^{-7}/^{\circ}\text{F}$ above ambient and $2 \pm 1 \times 10^{-7}/^{\circ}\text{F}$ below ambient temperature. To assure that the below ambient, $\sim 10\mu$ high open loop nature of the $\Delta L/L$ vs. T curves was not apparatus related, similar size quartz tubes (A and B) were checked and found to have only a 2μ (negligible for quartz) open loop component. These two quartz tubes, A and B, had ambient CTE values 20% and 45% respectively higher than the average handbook value ($.305 \times 10^{-6}/^{\circ}\text{F}$). The overnight microcreep diminished an order of magnitude during the first several cycles after the system had been reopened.

DESIGN OF AN X-RAY MICROSCOPE FOR USE WITH AN EXTENDED RANGE X-RAY TELESCOPE

Abd Kassim, S. Chao*, and D. L. Shealy*, University of Alabama in Birmingham, Birmingham, AL 35294

This research has been carried out in response to the request from the George C. Marshall Space Flight Center (MSFC), National Aeronautics and Space Administration, for designing an optimal x-ray microscope (confocal, glancing incidence, hyperboloid-ellipsoid, internally reflecting mirror system) that will couple with ATM experiment S-056 X-Ray telescope to an x-ray sensitive CCD detector. The desired result of putting a microscope between the telescope and the detector is the reduction of the telescope's high resolution. A ray tracing technique has been developed for computing the RMS spot radius and the point spread function. Calculations of the RMS spot radius as a function of the microscope's focal length, magnification, and mirror length have aided MSFC personnel in arriving at the final mirror design for optimum resolution of the system over the entire field of view.

Abstracts

TEMPERATURE DISTRIBUTIONS DUE TO JOULE HEATING IN CONDUCTING MEDIA

John H. Young, William J. Atkinson, and Ivan A. Brezovich,
University of Alabama in Birmingham, Birmingham, AL 35294

A general solution to the heat diffusion equation is given for the Joule heating of conducting media by steady-state electrical currents. The solution reduces the problem of solving the inhomogeneous diffusion equation to a simple boundary and initial value problem familiar to all intermediate-level students of physics, mathematics and engineering and should be useful in supplementing problem material in boundary value and heat conduction courses. Examples of the method are given and it is further shown that the general steady-state temperature solution indicates that, under certain conditions, the electrical equipotential surfaces will also be isothermal surfaces.

AXIAL MAGNETIC FIELD MEASUREMENTS IN A VACUUM SPARK PLASMA

Peter Beiersdorfer and Eugene J. Clothiaux, Dept. of Physics, Auburn University, AL 36849

The axial magnetic field generated by a vacuum spark plasma has been studied using inductive probes. A correlation between the onset and the strength of the axial field and the x-ray emission by the plasma is observed. It is found that the axial field strength is zero until the last x-ray burst has occurred. This shows that the mechanism that underlies the x-ray production has to preserve the axisymmetry of the current flow. The axial field is thought to be caused by a kink instability that disrupts the axisymmetry of the plasma thereby preventing any further x-ray production.

METEORITIC SPECTRA

Nicholas Gerontakis and Thomas J. Wdowiak, University of Alabama in Birmingham, Department of Physics, Birmingham, Alabama 35294

Meteoroid entry into the earth's atmosphere will be simulated. An examination of meteorite samples will be conducted by subjecting the samples at low air pressure to a high speed shockwave. A magnetically driven shock tube has been constructed for this purpose, allowing for shock wave speeds of up to Mach 22. Light emission from the samples will be analyzed with a Hilger E 612 F 5.7 2 prism spectrograph and a modified optronic Czerny - Turner spectrometer.

Gravitational Acceleration of an Extended Rigid Body

John H. Young, Department of Physics, University of Alabama in Birmingham, Birmingham, AL 35924

A derivation is given for the acceleration of the center of mass of an extended rigid body in a gravitational field. The lowest order corrections to the simple expression for the acceleration of a point mass are shown to involve the coupling of the inertia tensor of the body to field inhomogeneities. The significance of the size, structure, and orientation of the body is illustrated by the example of a spheroid in free fall in a spherically symmetric field.

CHARACTERIZATION OF EASTERN OIL SHALES BY PROTON NMR

J. W. Harrell, Jr. Dept. of Physics and Astronomy, Univ. of Ala., University, AL 35486

A study has been made on some Devonian oil shales to determine the feasibility of using hydrogen pulse NMR to measure the oil yield potential of raw oil shale samples. Preliminary measurements show that the hydrogen in the kerogen can be distinguished from other forms of hydrogen in the oil shale on the basis of relaxation times, and a simple measurement technique has been adopted which is most sensitive to the slowly relaxing kerogen. Measurements made on Alabama oil shale and shale-kaolin mixtures are found to be linearly correlated with the amount of extractable oil as determined by the Fischer assay method.

A SIMPLE METHOD FOR SOLVING THE SCHRÖDINGER EQUATION

S. T. Jones, B. C. Harms, and S. Denham, Dept. of Physics and Astronomy, The University of Alabama, University, AL 35486.

A simple scheme is described for numerically determining the eigenvalues of the schrodinger equation. The method applies to polynomial potentials and can be easily implemented on a microcomputer. The method of solution involves expansion of the wave function in terms of harmonic oscillator states. The coefficients of the expansion are determined, as a function of energy, by a recursion relation. The correct energy eigenvalue is determined by minimizing the norm of the wave function. The procedure converges rapidly, as will be illustrated by specific examples. Application of the procedure to a non-hermitian hamiltonian of interest in field theory leads to some unusual results.

Abstracts

INDUSTRY AND ECONOMICS

TECHNIQUES FOR EVALUATING HASHING FUNCTIONS

C. L. Friese, Dept. of Info. Systems, Auburn Univ. at Montg., Montg., AL 36193.

Applications in computer science and data processing that utilize "random access" is of fundamental importance since the search time is not a function of the number of records to be searched. Quite simply stated, a hashing function is a rule, or set of rules that converts a key into an address. Many hashing functions have been described in the literature, however, the problem of which of these to select for a particular application depends not only on the distribution of addresses generated for a particular set of keys, but also very critically on the techniques utilized for resolving "collisions" or synonyms. The synonyms occur when different keys generate the same address, which is an unavoidable property of hashing function. Both the total number of synonyms and the distribution of the synonyms with respect to the addresses are thus important parameters to be utilized in evaluation of candidate hashing functions for a particular application. These parameters depend, of course, on the distribution of the keys and hence each application must be evaluated independently. Techniques for the evaluation of a candidate hashing function in terms of the parameters will be presented. This is a critical step since the search for a "best" hashing function is infinite, when it is only necessary to find a function that is sufficient. The topic is not adequately covered without considering the critical influence of the method of synonym resolution on the criteria for a sufficient function. The choice of storage for the records also influences the criteria, and this effect will also be discussed.

THE STATE OF THE STATE IN MIS

Edward H. Kirsch

School of Business, Auburn University at Montgomery; Alabama Medicaid Agency

The author discusses the need for and current status of management information systems in the state government in eight functional areas; health and human services, financial, education, planning, natural resources and agriculture, criminal justice, transportation, and energy and utility regulation. He indicates that the state is generally behind industry in MIS development, but that new management is currently accelerating development. In a final statement, he indicates that the outcome of the forthcoming gubernatorial election could affect the MIS development.

Abstracts

THE LABOR SUPPLY EFFECTS OF NONPECUNIARY CONDITIONS OF EMPLOYMENT

Philip Gregorowicz

DEPARTMENT OF ECONOMICS, Auburn University in Montgomery

The primary purpose of this research is to investigate the effects of a variety of variables reflecting the nature of the nonpecuniary conditions of employment on individual hours of work choices. Included in this set of variables are attitude variables and indices of worker job satisfaction; also included are such factors as physical working conditions, the existence of job hazards, and the nature of work activities. This study will focus on the independent labor supply affects of such non-monetary variables and their impact on the estimated coefficients of the more traditional variables used in empirical labor supply models.

Analysis of the determinants of time allocation between market and nonmarket uses has focused on the impact of changes in wage rates and income. The estimated effect of these monetary variables on labor supply is highly dependent on controlling for individual taste differences in the uses of time. This problem is particularly relevant in explaining the post-World War II stability in individual labor supply inspite of substantial increases in income. Also, empirical estimates of the income effect generally are inconsistent with economic theory.

It is a maintained hypothesis in this research that the nonpecuniary conditions of employment serve as useful proxies for individual tastes for work not captured by other variables. Their omission from labor supply models results in biased parameter estimates for the monetary variables. This study attempts to verify these beliefs.

CHARACTERISTICS OF BUYERS AND SELLERS AT FARMER'S MARKETS IN ALABAMA

W. Joe Free and Veronica A. Vitelli. Resource Economics Section, TVA, Muscle Shoals, Alabama 35660.

The marketing systems for many horticultural crops are not well structured and small farmers not only face wide price variations but often cannot find buyers willing to handle their crop unless wholesale prices are severely discounted. For many producers where shipping buyers or producer's marketing associations are not available, direct markets to the consumer are an important alternative. As part of a broader project to identify and analyze impediments to effective market entry at local, regional, and national levels for southern fruit and vegetable producers having various resource endowments, TVA and Auburn University in cooperation with S129, surveyed farmers markets in Alabama. Survey results indicate that the 113 farmer-sellers at the markets sold one to six products with three being the average. Average plot size was 9.3 hectares (23 acres). Estimated average purchase by the 118 consumers surveyed was \$15.00 per visit. Twenty-four market managers were also surveyed. Survey results will be jointly published by the Auburn Experiment Station and as a Southern Regional Cooperative Bulletin.

Abstracts

PRICING AND PRACTICE BEHAVIOR OF SELF-EMPLOYED PHYSICIANS

James R. Seldon. Dept. Economics, AUM, Montgomery, AL 36193

Physician incomes after professional expenses in the East South Central Census Division in 1978 and 1979 were significantly above the mean for all U.S. physicians, even though Division per capita income was less than 82 per cent of the U.S. level. There were 26 per cent fewer physicians per capita in the ESC Division than in the U.S. as a whole, but the case was not simply one of restricted supply leading to higher prices. Reported ESC fees for standard medical and surgical services were consistently lower than in other Divisions. The higher average incomes resulted from those lower fees combined with twenty per cent more patient visits per hour of working time, and ten per cent more annual working hours. Higher demand per physician combined with similar physician supply conditions could be responsible for higher incomes, but would also imply higher fees. Lower fees could result from lower demand levels, but should be accompanied by lower incomes. Several explanations, none entirely satisfactory, are suggested for the output-fees-income pattern. ESC practitioners may have different tastes and preferences for income versus leisure or may face different auxiliary input prices. Alternatively they may face lower demands for their services at given prices but be more successful in practicing price discrimination. ESC physicians have adjusted so as to charge higher fees per hour of time spent in patient care, but unexplained is why physicians elsewhere have not adopted similar practice styles.

"REINSTATED BY THE ARBITRATOR"

H. Ellsworth Steele, Dept. of Economics, Auburn University, AL 36849

Labor arbitrators frequently order management to reinstate workers they have discharged, some with and some without back pay.

The return of these workers to their old workplaces may be traumatic for them, their supervisors and others. To explore this process, 51 cases from four manufacturing plants in the upper south were examined. Of these, 16 were explored through extensive interviews involving returned workers, supervisors, shop stewards and fellow workers.

Of the 51 workers, 43 not only returned to work but stayed long enough for their supervisors to rate them as "satisfactory" or "unsatisfactory." In the judgment of their supervisor, 60 percent of these returning workers became satisfactory employees.

The present report focuses upon the experience of a young man who had been terminated for fighting with a fellow employee. Through the worker's eyes and those of his supervisors, shop stewards and fellow employees, the fairness of the arbitrator's award, the worker's reception upon return, his treatment by supervision, his work performance and his feelings toward the company and the union are examined.

Abstracts

IMPLICATIONS OF THE 1980 RAIL DEREGULATION ACT ON ALABAMA GRAIN HANDLERS

W. Joe Free. Resource Economics Section, TVA, Muscle Shoals, Alabama 35660.

This paper discusses principles embodied in the rate provisions of the Staggers Act and the implications of these changes on Alabama grain handlers as a result of the Staggers Act. Five basic rail rate provisions of the Staggers Act are: (1) The Interstate Commerce Commission's (ICC) authority to regulate railroad rates applies only where no other competition exists, (2) The ICC can intervene if the rail industry is not earning adequate revenues, (3) Rail carriers have rate flexibility within limits, (4) A carrier participating in a joint rate movement that is not receiving an adequate share of the joint revenues may surcharge the traffic or cancel the joint rate and establish its own rate, (5) Carriers may enter into contracts for transportation services without regulation by the ICC. Some guidelines that Alabama grain handlers should consider in developing rate strategy in light of the new Act include: (1) Rates in existence on October 1, 1980 could have been challenged as unreasonable via the "savings-clause" before March 29, 1981, (2) Seek competitive transportation alternatives, (3) Develop a clear understanding of variable costs for transportation moves and negotiate, (4) Enter into contract rates for minimum volume shipments and steady flow of traffic, (5) Consider costs and benefits involved in purchasing the line.

THE POTENTIAL FOR ELECTRONIC SELLING OF FRUITS AND VEGETABLES

W. Joe Free and Veronica A. Vitelli. Resource Economics Section, TVA, Muscle Shoals, Alabama 35660.

Technological advances in data processing and communications have made electronic trading possible. Sale by description is necessary for electronic trading between parties in different localities. Electronic selling increased competition in the market place by improving market knowledge among buyers and sellers and enlarging the trade area by putting a large number of sellers and buyers in contact simultaneously. It maximizes efficiency and competition in negotiated transactions. TVA is working with Land-Grant Universities, Farmers Cooperative Service, Eastern Electronic Association, and a number of fresh wholesale vegetable markets to develop an electronic market system for fresh fruits and vegetables. Fresh fruits and vegetables are an important industry in the South where over one-fourth of the total US supply is produced. Most is sold by description via a network of telephone brokers from spatially separated producers to spatially separated wholesale buyers. The technology to market fresh fruits and vegetables electronically is available but the trade participants have not been organized. TVA recognized a need for the system among sellers and established a pilot program in 1981 with selected packinghouses to develop a computerized recordkeeping system which will provide the framework for a pilot electronic marketing program for fresh fruits and vegetables. This is the first system especially designed for wholesale trading of fruit and vegetables. The system has wide application throughout the Tennessee Valley region and the nation once perfected and accepted.

Abstracts

THE IMPORTANCE OF "INFLATION ACCOUNTING" FOR AGRIBUSINESS-- A CASE STUDY OF THREE FIRMS

Veronica A. Vitelli. Resource Economics Section, TVA, Muscle Shoals, Alabama 35660.

The time value of money has never been more important. High interest rates, new financing arrangements, decisions as to lease or buy, all accentuate the need for "inflation accounting" among agribusinesses. Conventional accounting techniques describe the overall asset position of the firm, as well as past services and use of funds. This data is of little value for financial planning without modification to incorporate the changing value of money over time. Inflation accounting refers to the ability of management to incorporate the changing value of money into records of the company so that they be used for making decisions. Present value analysis is considered the best financial management decision tool in evaluating investment alternatives because cash flows are "discounted" over time. Profit motivated agribusiness firms must incorporate financial management techniques that include the changing value of money when estimating future produce prices, wage rates, material costs, and methods of operation. Replacement Cost Accounting is one specific tool that agribusiness firms should adopt--even if it means keeping two sets of records. Management audits with three agribusiness firms revealed that none used "inflation accounting." All three kept records primarily for filing taxes. While the tax records revealed that these firms were solvent, they did not exploit company data in planning, especially for capital expenditures and in preparing pro forma and cash flow statements. This could be catastrophic during inflationary periods.

HAS KEYNESIAN ECONOMICS REALLY FAILED

A. Wayne Lacy and Katherine M. Graves,
Department of Economics, Auburn University at Montgomery
Montgomery, AL 36193

This paper addresses the question of whether Keynesian economic methodology as prescribed by theory has given rise to the problems of the U.S. economy or because of a failure to apply Keynesian theory appropriately or at all. A year by year analysis for 1960-1980 examines economic conditions and the policy applied to determine if the policy was in fact the Keynesian prescription.

The analysis reveals that while some years provided excellent examples of Keynesian application, a large percentage did not. Most notably, in the 1970-1980 decade, the Keynesian anti-inflationary policies in general were not followed. Much evidence exists in the data to demonstrate that while Keynesian expansionary policies were often pursued vigorously, Keynesian contractionary policies were not except for short periods.

TRENDS TOWARD THE CONSERVATION OF ELECTRICITY IN ALABAMA

Jim Coleman, Ala. Power Co., Mkt. Services Dept., Birmingham, AL 35291

The Company administers a residential customer survey biennially to monitor the changes in appliance saturations, demographics, dwelling characteristics and energy conservation. The latest survey, which consisted of a sequential random sample of 1,006 from a total population of residential customers, was conducted in May, 1981. The analysis of the energy conservation data collected is directed to the quantification of the behavioral aspects of customer conservation. In other words, what are customers doing to conserve energy? These elements are examined on the basis of group segmentation. These groups are designated as "energy effort profiles," (level of effort to conserve) newer versus older dwellings, type of air conditioning and type of space heating. The total sample data is compared to these groups and certain trend data are examined. From the study, we can make the following general conclusions: (1) The trend to conserve energy continues to increase; (2) "Energy effort profiles" tend to substantiate the customer's personal evaluation of whether he or she is applying a determined effort or some effort or no effort to conserve energy; (3) A high percentage of customers with electric water heaters, electric ranges and electric clothes dryers are making efforts to conserve; (4) Customers in dwellings, 5 years or less, tend to conserve more energy than those in older dwellings; (5) Central air conditioning customers apply more significant measures to conserve than those with window units; (6) Electric space heating customers make a greater effort to conserve than those with other fuels.

OPTIMIZING THE COST OF CAPITAL: A SIMULTANEOUS DETERMINATION

Raymond M. Johnson, Dept. of Accounting & Finance, Auburn University at Montgomery, Montgomery, Alabama 36193.

This paper reconsiders the issue of the firm's optimal capital structure and the resulting optimal cost of capital within a model which incorporates a "budget constraint" in the form of the firm's balance sheet. Optimization is considered both from the standpoint of assuming the presence and absence of risk in the model. When uncertainty is present in the model, the paper shows that the optimal capital structure and consequently the optimal cost of capital are indeterminate without considering the covariance between the sources of capital. The paper presents a technique for simultaneously determining the optimal components of capital which incorporates the covariance considerations.

Abstracts

THE EFFICIENCY OF THE SOYBEAN FUTURES MARKET IN FORECASTING CASH PRICES

Philip Gregorowicz, Gayden Green and Carl McDevitt
School of Business, Auburn University in Montgomery

It is generally argued that organized futures markets improve on resource allocation and reduce price volatility in cash markets by providing market participants mechanisms to: (1) stabilize revenues by shifting price volatility risks, (2) acquire information about futures conditions, (3) hold efficient levels of inventories over time. Standard theory of price determination in futures markets for continuously storable commodities stresses the role of futures markets on inventory adjustments. Futures market prices are viewed as reflecting the cost of storing such commodities. However, recent research has focused on the forecasting function of these markets.

The purpose of this paper is to examine the effectiveness of soybean futures market in providing accurate forward prices or forecasts of subsequent soybean cash prices. The efficiency of these forecasts is tested by means of a simple linear regression model. Actual cash prices are regressed on the earlier futures prices of soybeans. If futures prices correctly forecast subsequent cash prices then the intercept of the regression equation will be zero and the slope unity. Should these results be achieved, futures prices can be argued to be 'unbiased estimates' of cash prices.

The data on which these statistical tests were performed was limited to the 35 soybean contracts maturing in 1977 through 1981. This period reflected high levels of uncertainty and price volatility.

A UTILITY LOOKS AT LIFELINE RATES

Fred Norrell. Energy Services Dept., Ala. Power Co., Birmingham, AL 35291

Cost justification for lifeline rates is explored. Load shapes for various groups of customers (including the poor, the elderly poor, and those without air conditioners) are examined. The study concludes that income and energy use are not reliable predictors of load shape, whereas appliance mix is. Residential customers without air conditioners and those with heat pumps have load shapes significantly flatter than residential customers as a whole. Thus, cost-justified lifeline rates may be appropriate for customers with specified appliance mixes, but these results cannot correctly be extended to particular socioeconomic groups.

Abstracts

INTERNATIONAL TRADE IN SOYBEANS: IMPLICATIONS FOR ALABAMA

James L. Stallings, Dept. of Ag. Economics, Auburn Univ., Auburn Univ.,
AL 36849

International trade in soybeans is extremely important to Alabama farmers and agribusiness in that over 1 out of every 2 acres of harvested cropland is required for Alabama's export share of U.S. exports. The value of Alabama's export share in terms of prices received by farmers was \$216.5 million in 1980. The U.S. is the world's most important soybean producer with nearly 2/3 of world production. Only Brazil, the People's Republic of China and Argentina are other important producers. The U.S. accounted for 81.7% of the whole soybeans, 37.4% of the soybean meal, and 33.7% of the soybean oil exported in the world in 1977-1981. The most important customers for U.S. and Alabama soybeans and products include Netherlands and Japan for whole soybeans; Netherlands, W. Germany and Italy for soybean meal; and, India and Pakistan for soybean oil. Trade policies most affecting U.S. and Alabama, with respect to soybeans, include the various policies of the European Economic Community, Japan, Brazil, and Argentina, which either result in trade restrictions or subsidize their own producers and processors in competition with the U.S. Important issues for U.S. and Alabama farmers and agribusiness include the requirement that a certain percentage of soybeans and products must be shipped in U.S. vessels, a possible grain embargo of the U.S.S.R. and Poland, completion of the Tennessee-Tombigbee waterway, expansion of the facilities of the Port of Mobile, foreign exchange rates, and the soil mining aspects of increased production of soybeans for export from the U.S. and Alabama.

SCIENCE EDUCATION

PREPARING PLANETARIUM PROGRAMS

Carole Rutland, Patterson Planetarium, Columbus, GA and
Dutchie S. Riggsby, Columbus (GA) College

This presentation develops an approach for the production of low-priced audiovisual materials for use in planetarium programs. As more school systems add planetaria to their facilities, the need to be able to locally produce standard programs as well as special effects material-increases. Among the variety of media production described are slides, film loops, panoramic slides, slides with motion (polarizing techniques to simulate motion), and a broad range of titling techniques exemplary of which is Kodalith. A major thrust of the paper is the production of planetarium materials on minimum budget.

A CURRICULUM STRATEGY FOR ENERGY EDUCATION

A. J. Atkins. Dept. of Curriculum and Teaching,
Auburn University 36849

During the last twenty-five years numerous efforts have been made to effect curriculum changes in the science courses of the secondary school. The first major effort was associated with the Sputnik era when considerable sums of money were made available through the National Science Foundation. Since the end of that era, and particularly during the past decade, numerous efforts have been witnessed to have such topics as ecology, sex, alcohol abuse, drugs, environmental education, career education, scientific creationism, and others taught in the science curriculum. Few efforts of this latter era have met with notable success for numerous reasons. The current topic of energy education may be viewed as but another such topic. There are ways in which energy education can be incorporated into all science courses with no great expenditure of time or money. These are (1) to teach science within a framework of a concept of that energy which is a natural and concomitant part of the science being taught; and (2) place emphasis on teaching for the transfer of what is learned about energy to everyday practical situations. This proposal is not offered as a panacea but as a natural and practical way to begin a program of energy education in secondary schools.

A SIMPLE EXPERIMENT ON TWO-DIMENSIONAL COLLISIONS

S. T. Jones, Dept. of Physics and Astronomy, The University of Alabama, University, AL 35486.

The collision between two pendulum bobs hanging from a common point provides an extremely simple experiment in 2-dimensional collisions. For small angles, the velocity before collision is just proportional to the linear distance the bob has traveled, so that measuring velocities is trivial. Both elastic and inelastic collisions can be studied with ease, and of course, the equipment is cheap. This provides a much-needed illustration of the vector nature of momentum for beginning students.

Abstracts

THE EDUCATION SERVICES DIVISION OF THE NATIONAL AIR AND SPACE MUSEUM AND THE REGIONAL RESOURCE PROGRAM-- AVAILABLE ASSISTANCE FOR LOCAL SCIENCE EDUCATION

Ernest D. Riggsby, Columbus (GA) College

This paper describes the Regional Resources Program of the National Air and Space Museum. Begun in 1979, the Regional Resource Program of the National Air and Space Museum has grown to a total of 48 trained regional resource persons. Training for these resource persons is provided at the facilities of the National Air and Space Museum, Washington, D.C. Schools and other organizations interested in utilizing the services of a regional resource person or one or more of the many science education programs and facilities of the NASM, should contact the Smithsonian Institution, Educational Services Division, National Air and Space Museum, Room P-700, Washington, D.C. 20650 and ask for additional information including the name, address, and telephone number of the regional contact nearest the location of the institution making the request for information and services.

TEACHING AIDS AND METHODS UTILIZED BY UNIVERSITIES AND NONEDUCATIONAL INSTITUTIONS

Dr. Marlon C. Rico and Dr. William S. Stewart, Dept. of Marketing and Management, Univ. of No. Ala., Florence, AL 35632-0001, Dr. Ursin S. (Pete) Walker, School of Education, Delta State Univ., Cleveland, MS 38732.

This paper provides an exploratory analysis of 30 teaching aids and methods utilized during the Fall of 1981 by two universities, a military installation, a public utility, and a private business firm. Within the universities, data was tabulated by individual school, and it appears that the Schools of Education are using a wider variety of methods in their teaching efforts. The teaching methods used most often by all schools in the university setting were lecture and discussion, and the teaching aid with the greatest frequency of use was the chalk board. Noneducation institutions made greater use of team teaching, programmed instructions, games and simulation, and pre-packaged learning materials. All organizations, both the universities and the noneducational institutions used problem solving to a high degree as a teaching method. This study suggests that university faculty may not be utilizing, to the fullest extent, the most advanced teaching aids and methods.

Abstracts

THE STS AS A RESOURCE FOR MIDDLE SCHOOL SCIENCE TEACHING: STUDYING THE SPACE SHUTTLE IN THE CLASSROOM

Eleanor Eubanks, Gentian Elementary School, Columbus, GA
Ernest D. Riggsby, Columbus (GA) College and Dutchie S. Riggsby,
Columbus (GA) College

Teacher-made and teacher-edited instructional materials for science units on the space shuttle and the encounters with the planetary systems of Jupiter and Saturn by Voyager I and Voyager II were the thrust of this paper. The authors and presenters were on site at Cape Kennedy for the launching of STS-I and STS-II and at the Jet Propulsion Laboratories at California Institute of Technology for the planetary flyby of both Voyager I and II. Slides, overhead transparencies, video-tapes, motion picture footage, models and posters are among the media produced. Several examples of student-made teaching materials were also included. Additionally, photocopying materials made available from the National Aeronautics and Space Administration and integration into suitable format for use in individual classrooms was presented.

FALCON FORCE: AN UPDATE ON THE REVISED EDITION OF A MIDDLE SCHOOL AEROSPACE SCIENCE PROGRAM

Eleanor Eubanks, Gentian Elementary School, Columbus, GA
Dutchie S. Riggsby, Columbus (GA) College and Ernest D.
Riggsby, Columbus (GA) College

Described and discussed in this paper is the revised edition of Falcon Force, a multimedia, interdisciplinary program for middle school science students centered upon space science as a core of information and skills to be supplemented by art, English, mathematics, social studies, and other disciplines. Largely subsidized by the Civil Air Patrol, the Falcon Force kit is available at less than half the cost of a fully commercially produced effort. The investigation included in this paper is the second year of a two-year experimental program using Falcon Force in fifth and sixth grade classes. The results of the first year (pilot) study of the program resulted in the identification and execution of several desirable revisions in the program. Additionally, the kit has been expanded to include duplicate copies of several items.

SOCIAL SCIENCES

THE FEDERAL ENDEAVOR: THE FREEDMEN'S BUREAU
AND LABOR REORGANIZATION IN ALABAMA, 1865-1869.

John B. Myers, Dept. of History, Columbus College, Columbus, GA 31993

One of the urgent problems which confronted post-war Alabama was labor reorganization. The transition from slave to free labor touched every phase of Alabama life. Many whites, skeptical of free black labor, viewed the future pessimistically, while claiming that the country was ruined because blacks would not work "without the lash." Though the freedmen's reluctance to work was exaggerated, they were hesitant to negotiate with whites due to distrust and a lack of bargaining experience. The task of resolving the labor problem was assigned to an agency of the Federal government known as the Freedmen's Bureau. Alabama Bureau Commissioner, Wager Swayne, was ordered to introduce a practical labor system and to resolve related labor grievances and abuses. In May, 1865 he published labor regulations for Alabama; which permitted employers and employees to enter contracts, provided they were "fair and honest to laborers and approved by a Bureau agent." Post-war poverty and lack of capital in Alabama encourage utilization of the sharecrop system. This system, although scrutinized by the Bureau, was a "rather informal affair" with a variety of arrangements. Crop failures and other economic problems, combined with white employers' lack of confidence in black labor brought about widespread abuses of the contract system in 1865, 1866, 1867 and 1868. By the end of 1868, the Federal government decided that the Freedmen's Bureau was no longer required. Despite the prevailing unsettled economic, political, and social atmosphere, the Freedmen's Bureau, black labors' Federal ally departed from Alabama in 1869

SAMUEL ELBERT AND THE EAST FLORIDA CAMPAIGNS, 1777-1778

David S. Heidler, Dept. of History, Auburn University, AL 36849

In the early years of the American Revolution, Georgia patriots were rankled by provocative and harassing raids along their southern border. Those raids originated from a small, yet belligerent, garrison at St. Augustine in East Florida. The patriots in Georgia became virtually fixated upon the idea of reducing this garrison as a prerequisite of revolutionary participation. Samuel Elbert had the misfortune to be placed in charge of the 1777 expedition to accomplish this objective. This expedition was marred by political quarrels and incautious planning, and it was formidable only in the danger it posed to Georgia forces. Elbert succeeded in avoiding the destruction of his command and, in the following year, participated in an equally quixotic effort against the British. Yet Elbert did manage to inflict little harm on the patriot cause in 1777; and in 1778 he managed to deliver it a small triumph. Hence, this is the story of success amidst futility.

Abstracts

INTERGOVERNMENTAL RELATIONS: REAL CHANGE OR MORE OF THE SAME?

Barbara M. Giles and Donald E. Hayhurst. Dept. of Political Science, Auburn University, Auburn, Alabama 36849

This paper analyzes trends in intergovernmental relations from 1960 to 1980. Specifically it focuses on the attempts of Reagan's Administration to restore balance to the intergovernmental structure and speculates about his chances for achieving real change. From 1960 to 1980 there was an increase in the number and cost of categorical grants which were accompanied by an increase in federal mandates. An imbalance resulted within the federal system whereby the federal government became the center of power. With the introduction of block grants and revenue sharing, particularly during Nixon's Administration, unsuccessful attempts were made to return power to state and local governments. Thus, the decade of the 1970's ended with categorical grants remaining the primary source of financial assistance and real power being maintained at the federal level. With the administration of Ronald Reagan efforts to restructure the balance of power within the federal system are being renewed. During the first year of his term Reagan focused on cutting the growth of federal domestic spending and restoring power to states, both goals being served by more extensive use of block grants. As he embarked on his second year in office, he has proposed pursuing these goals further in his "New Federalism" program. In assessing prospects for change, efforts of Reagan's Administration are compared with those of Nixon's. Differences in composition of Congress, personalities of individuals and changes in state government are addressed. On this basis speculation about real change is made.

SPANISH MEDICAL CARE IN THE MOBILE DISTRICT: ADVANCED OR RETARDED?

Sir Jack D.L. Holmes, Ph.D., Birmingham, Alabama 35205

Contrary to "black-legend" anti-Spanish writing about medical care under Carlos III and Carlos IV to 1808, crown policy was to provide university-trained surgeons and physicians, medics (practicantes), orderlies, nurses, and a hospital hierarchy to oversee equipment. Pharmacists, as other medical personnel, had to be licensed after an exam by the board of medical examiners. In the Mobile District, 1780-1813, The Treasury's fiscal agent or guarda almacén, supervised medical care in the Royal Hospital on Dauphin Street. Fort Confederation and Fort San Esteban de Tombecbé had medical care, as did Fort Stoddard under American control in 1799. Careful records show type of medicines used, size of hospital beds, payroll for medical personnel, and the pensions provided for military and civilian doctors. Foreign books were translated into Spanish and made available to surgeons at Mobile. Modern quarantine methods developed at New Orleans in 1779 were followed by other colonial powers who used Dr. Gil's 1786 treatise. Brunonian theory of treatment characterized Spanish medical care.

REAGAN'S NEW FEDERALISM: CAN CITIES AND STATES COPE?

David W. Sink. Dept. of Urban Studies, UAB, Birmingham, AL 35294.
David L. Martin. Dept. of Political Science, Auburn Univ., AL 36849.
Arthur S. Wilke. Dept. of Sociology and Anthropology, Auburn Univ.,
AL 36849.

The theme of this panel discussion rests upon an understanding of the connectivity between each of the parts of government in the U.S. --national, state, and local. Since President Johnson's Great Society concentration on categorical grants created a strong and direct link between national and local governments, three Republican presidents have sought to return decision-making rights to the cities as well as interject state governments into that relationship. For some cities in several states, this alteration poses few major problems. For many other cities (and urban counties as well) in states with legislatures and bureaucracies lacking in true governmental capacity and will, such a decentralization of authority may create hardship and a new set of intergovernmental challenges. This tenuous status may be further aggravated in states where locales lack home rule, enjoy limited taxing authority, and/or suffer from long-standing opposition from rurally-based legislators and chief executives. Conversely, proponents of the current administration's plan argue that important decisions should be made by governments closest to the people they affect. Opponents are concerned that most states are unable or unwilling to assume the responsibilities to be thrust upon them and believe that the net effect of the New Federalism would be simply fewer services for the needy.

SAVING SLOSS

Sloss Furnace No. 1 went into blast April 12, 1882 as one of a long line of industrial plants along the railroad reservation which bisected Birmingham, Alabama. Furnace No. 2 began pouring iron the following year and the two continued to light up the sky in Birmingham until 1970 when they were the only downtown furnaces left. However, stringent requirements of the Environmental Protection Agency caused U. S. Pipe Company, the 1970 owners, to shut down rather than meet the heavy investment.

What should be done with acres of historic blast furnaces in downtown Birmingham? Conflict arose immediately between "Tear it down, bring in new business on this prime site and have jobs" and "Save Sloss! it is the only furnace of this era still standing in the USA!"

Today the furnaces are a National Landmark, listed on the National Register of Historic Places and is recorded in the Historic American Engineering Record. April 12, 1982 will bring the Centennial Celebration as work proceeds to modify the site for an Iron and Steel Museum--first one in "The Pittsburgh of the South." From scheduled demolition to Centennial Opening is a testimonial to the power of private citizens banded together.

Helen Mabry

HEALTH SCIENCES

TRANSFERRIN LEVELS IN PATIENTS WITH IgG AND IgA DEFICIENCIES
COMPARED TO NORMAL ADULTS

K.S. Yackzan, B.M. Gray, and P.L. Haber, Diabetes Research and Training Center, and Department of Pediatrics, University of Alabama in Birmingham, AL 35294

In addition to its established functions in iron transport and metabolism, transferrin is also thought to play a role in normal host defense by binding iron and making it unavailable to bacteria, and thus reduce the growth potential of such iron-requiring pathogens as *Pseudomonas*, *E. coli*, *Shigella*, *Neisseria*, and *Listeria*. A previous report suggested that transferrin levels were increased in patients with immunodeficiencies. We therefore examined transferrin levels in 14 adult patients with acquired agammaglobulinemia. Their mean transferrin was 304 mg/dl (SD=81), compared to 253 mg/dl (SD=35) in 22 normal adult laboratory personnel and medical students ($P < 0.02$). Nine patients with IgA deficiency had transferrin levels averaging 273 mg/dl (SD=87), and five patients with X-linked agammaglobulinemia averaged 272 mg/dl (SD=108), which was not significantly different from the normal controls. To see if transferrin might be normally increased in a specific disease state, we measured levels in 11 infants (mean age 13 months) with acute otitis media, using serum samples from the same infants at well-child visits as controls. Transferrin levels at the time of illness averaged 369 mg/dl (SD=80, N=11) and was not significantly different from levels (mean=401, N=15, $P=NS$) when they were healthy. Both infants and the adults with acquired agammaglobulinemia had transferrin levels elevated with regard to normal adults. Thus while a host defense role for transferrin was not established, our results point in that direction.

Effects of Dietary Fiber on Carbohydrate Metabolism
in Class A (Gestational) Diabetics

Richard O. Davis, Betty Darnell, and John F. Huddleston, Dept. of Obstetrics and Gynecology, Univ. of Alabama in Birmingham, Birmingham, AL 35294

The purpose of this study was to evaluate the impact of dietary fiber on carbohydrate metabolism in Class A Diabetes in pregnancy. Since glucose control toward normal levels is associated with decreases in perinatal morbidity and mortality, dietary modifications which offer increased control of glucose levels toward normal would be clinically beneficial.

In Class A Diabetes, increased fiber reduced the average postprandial glucose levels when compared to the standard 2200 calorie ADA diet. There were no differences in fasting glucose levels. There was a downward trend in insulin and glucagon levels but this was not statistically significant.

TESTICULAR TERATOMAS IN TRANSPLANTED EMBRYONIC MOUSE GONADS

Gregory S. Cameron and C.P. Dagg. Dept. of Biology, University of Alabama in Birmingham, Birmingham, AL 35294

Stevens has shown that embryonic genital ridges taken from F₁ hybrids of inbred strains 129/SvSl/+ and A/HeJ mice and transplanted to histocompatible adult hosts form teratomas in a high percentage of the grafts that come from male embryos. It has been suggested that these tumors arise from the germ cells of the graft tissue. Urethane and cyclophosphamide (cytoxan) are known to damage the germ cells of adults and to damage DNA. Caffeine is thought to be a DNA repair inhibitor and has been shown effective in altering the action of urethane on embryos. In order to determine whether germ cells are responsible for the formation of these teratomas, embryos were treated in utero with caffeine at a dose of 0.1mg/gm body weight of the pregnant female, urethane at a dose of either 0.5mg/gm or 1.0mg/gm, cytoxan at a dose of 0.01mg/gm, or a combination of caffeine and urethane or cytoxan. When given in combination the caffeine was administered at a dose of 0.1mg/gm 3 hours prior to and 3 hours after urethane or cytoxan. The embryos were treated on day 10 of gestation and the ridges transplanted on day 12. When compared to controls(87%), the caffeine(89%), cytoxan(82%), or the caffeine-cytosan(80%) had no significant effect on the rate of teratoma formation. However, there was a linear dose response for the rate of teratoma formation and the dose of urethane administered. A dose of 0.5mg/gm of urethane resulted in a rate of 57% and a dose of 1.0mg/gm resulted in a rate of 29%. Caffeine enhanced the effect of the urethane and further reduced the rate to 8% in the caffeine-urethane treated ridges. This reduction is the result of a decrease in the number of germ cells.

INFECTIOUS MEDIASTITIS IN A UNIVERSITY HOSPITAL

Barbara K. Williams, Div. of Infectious Diseases, and Michael Maetz, School of Public Health, University of Alabama in Birmingham, Birmingham, AL 35294.

Infectious mediastinitis is an important and life-threatening complication of many types of cardiac surgical procedures. To elucidate the extent of this problem and its patterns of occurrence at our institution we reviewed the medical records of open-heart surgery patients, laboratory culture results, operating room records, and Infection Control daily surveillance data. We found that the incidence of mediastinitis has increased from 1.41 cases/1000 in 1975 to a peak of 14.12 cases/1000 in 1980; 9.59 cases/1000 were seen in 1981. The incidence of mediastinitis increased with the number of cases done ($r = 0.72$; $p < 0.01$). The extremely high rate of mediastinitis seen in 1980 was due to a cluster of cases caused by Enterobacter aerogenes which occurred in the fall of that year. The increasing incidence of this problem at our institution underlies the importance of implementing effective preventive measures.

Abstracts

EFFECT OF FLURBIPROFEN ON MYOCARDIAL INFARCT SIZE

David E. Chambers and James M. Downey, Department of Physiology, University of South Alabama, Mobile, AL 36688. D.M. Yellon and D.J. Hearse, The Rayne Institute, London, U.K.

Flurbiprofen reportedly reduces the extent of myocardial tissue injury 6 hr. after the onset of ischemia. The present study was designed to test whether flurbiprofen continues to limit infarct size 24 hr. after coronary occlusion. A cannula was inserted into the coronary artery via the carotid artery of a closed chest dog. A plastic bead was injected through the cannula to cause a coronary occlusion, followed by Ce^{141} labelled microspheres into the left ventricle. The animals were then divided into 4 groups: Group I, 24 hrs.; Group II, 24 hrs of ischemia plus flurbiprofen (1 mg/kg every 8 hrs.); Group III, 6 hr. control; and Group IV, 6 hr. ischemia plus flurbiprofen (1 mg/kg). After 6 or 24 hrs. the animals were re-anesthetized and the hearts were removed and sectioned. Autoradiography of the microspheres was used to determine the perfusion field of the occluded artery which was considered to be the region at risk, and the necrotic zone was determined by staining with triphenyl tetrazolium. The infarct:risk zone ratio was $.84 \pm .05$ for the 24 hr. treatment group and $.91 \pm .04$ for the 24 hr. controls. These differences were not significant. For the 6 hr. treatment group, the infarct:risk zone ratio was $.21 \pm .07$ and for the 6 hr. controls it was $.78 \pm .13$. These values were significantly different. Thus, although flurbiprofen may delay injury assessed at 6 hr., all condemned tissue will have died by 24 hr. in spite of the drug.

SUFFERING REPORTED BY ADULTS WITH LUNG CANCER

Susan Benedict Yu, School of Nursing and Julian Bird, Dept. of Liaison Psychiatry, The University of Alabama in Birmingham, Birmingham, Alabama 35294

Many inferences are made about the phenomenon of suffering in persons who have cancer. Suffering, though frequently discussed, is difficult to study because of its subjective and unique nature. In this study, 25 patients participated in interviews and 10 completed written questionnaires about personal suffering resulting from the experience of cancer. Nine of these patients ascribed the presence of suffering principally to fear of disease recurrence, anxiety, disability, physical pain, and depression. In contrast, altered body image, financial problems, family problems, and difficulties with physicians and nurses were not reported as major causes of suffering by this group of patients.

Abstracts

AN IMPROVED CYTOGENETIC METHOD FOR THE DIAGNOSIS OF FANCONI'S ANEMIA

A.J. Carroll, N.C. Robinson, and W.H. Finley. Laboratory of Medical Genetics, University of Alabama in Birmingham, Birmingham, AL 35294.

Fanconi's anemia(FA) is an autosomal recessive disorder characterized by pancytopenia, short stature, hypoplasia to aplasia of the thumb, spontaneous chromosome instability, and a variety of other anomalies. Variability of both phenotype and age of onset of anemia makes diagnosis difficult, particularly in those patients who manifest few or no FA clinical features other than bone marrow insufficiency. Spontaneous chromosome breakage, ranging from none to high levels, has been reported to vary from patient to patient as well as within the same patient over a period of time. We studied the frequency of chromosome breakage in cultured lymphocytes from FA patients, FA parents and siblings, patients with idiopathic aplastic anemia, and controls. Spontaneous breakage frequencies in FA patients ranged from 0.08 to 0.40 with a mean of 0.24 breaks/cell while in controls the range was 0.00-0.04 with a mean of approximately 0.01 breaks/cell. Following exposure to 0.1µg/ml of diepoxybutane(DEB), cultures from FA patients exhibited an approximately 100-fold increase in chromosome breakage compared to that from cultures of the other similarly exposed groups. A marked increase in the number of radial figures accompanied this increase in FA patients. The use of DEB greatly simplifies the cytogenetic assessment of FA patients by reducing the number of cells which must be examined and overcoming the problem presented by FA patients with an only slightly elevated spontaneous breakage frequency. We were unable to detect significant differences in chromosome breakage between FA family members and controls using this method.

AGE DIFFERENCES IN MEMORY FOR SELF-GENERATED EVENTS

Jane F. Crockard, Div. of Psychology, Spain Rehab. Center, B'ham, AL 35294

In some areas of memory research, old people do show a decrement in performance when compared to a younger group; while in other areas, the age differences have been minimal. Recent findings of superior retention for self-generated events among young adults raises the question does this self-generation phenomenon exist for older adults. In young and old age groups, three experiments compared the retention of events presented by the experimenter to events generated by the subjects themselves. The results all showed a significant superior retention of self-generated events.

In a fourth experiment, the number of times subjects in young and old groups saw and generated words was varied. Half of the subjects in each age group were asked to judge the frequency of the words they read and half were asked to judge the frequency of the words they generated. Subjects in all age groups were more sensitive to the relative frequency of internally generated, compared with externally generated events.

MODIFICATION OF THE ACTION OF DMT BY N,N-DIETHYLCARBOXAMIDES

C. Patrick Lane, Al Panu and John M. Beaton, Neurosciences Program, Univ. of Ala. in Birmingham, Birmingham, Ala. 35294.

It has been hypothesized that the major hallucinogenic agents, e.g., mescaline, N,N-dimethyltryptamine (DMT) and lysergic acid diethylamide (LSD) all may act at the same central receptor in brain. To study this hypothesis we have synthesized and tested the ability of several agents to prevent or modify the behavior disruption induced by these hallucinogens. One compound, 1-methyl-1,2,5,6-tetrahydropyridine-3-N,N-diethylcarboxamide (THPC) successfully blocked the disruptive effects of DMT and LSD. In the present study the actions of two compounds related to THPC are discussed. These compounds are 1-methyl-4-oxo-3-piperidine-carboxylic acid N,N-diethylamide (AL #1) and 1-methyl-4-hydroxy-3-piperidine-carboxylic acid N,N-diethylamide (AL #2). These compounds were tested on a group of eight Long-Evans rats trained to bar press on a variable interval 30 sec. schedule of food reinforcement. The compounds were tested singly at 10 and 20 mg/kg and had no significant effects on behavior. They were then administered at these doses and 30 min. later 5 mg/kg of DMT was given. Only AL #1 at 20 mg/kg significantly blocked the disruption normally observed after the administration of 5 mg/kg of DMT. AL #2 at 20 mg/kg did modify the effects of DMT, but did not completely block the disruption. Compound AL #1 is currently being examined on other procedures to confirm its anti-hallucinogenic effects. (Supported in part by the Alabama Consumer Fund.)

MANAGEMENT OF HIGH RISK MATERNITY PATIENTS AND
LOW BIRTH WEIGHT INFANTS IN ALABAMA: A SURVEY

R.L. Dyer, R.L. Goldenberg, K.G. Nelson, and J.B. Wayne. School of Public Health, Dept. of Obstetrics and Gynecology and Pediatrics, University of Alabama in Birmingham, Birmingham, AL 35294.

Since the physician's perception of infant viability affects management decisions affecting survival, physicians in Alabama were surveyed to determine their level of knowledge about survival of low birth weight/early gestational age infants. Two hundred and sixty nine (269) physicians delivering babies in Alabama in 1979 were identified, and one hundred seventy seven (66%) responded to one of four mailed questionnaires. The study showed that the majority of physicians underestimated the survival success of the hospitals in which they deliver and at Regional Perinatal Centers.

A hypothetical case was posed to the delivering physicians and a series of possible clinical interventions were examined at gestational ages from 24 to 36 weeks. Analysis revealed considerable variability in the gestational age at which the interventions would be undertaken. Demographic characteristics of MDs who deviated from generally accepted medical practice were highlighted.

THE EFFECTS OF TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION IN
ENDORPHIN AND CORTISOL LEVELS IN NORMAL ADULTS

W. Jimenez, J. Clelland, K. Francis, University of Ala. in Birmingham

The recent discovery that the brain and pituitary gland produce opioid peptides has aroused interest in their physiological functions. Some evidence shows that they may serve as neurotransmitters in the brain and influence pain perception and behavior. It is becoming increasingly evident that these peptides may not function tonically but influence physiological processes on a selective manner only under specific environmental or endogenous conditions. Evidence now indicates that endorphins are released from the pituitary gland in response to stress along with adrenocorticotrophin (ACTH) and relationships exists between the two classes of peptides. Transcutaneous electrical nerve stimulation (TENS) is widely used in the control of pain and is believed to activate this system. The purpose of this study was to investigate the effects of the two different forms of TENS on the pituitary hormonal system by measurements of changes in blood levels of endorphins and cortisol.

26 subjects were randomly assigned to one of three groups: control, conventional TENS, and acupuncture-like TENS, with treatments lasting 30 minutes. Pre and post treatment blood samples were drawn and analyzed for endorphin and cortisol levels. There were no significant differences in blood serum cortisol values (pre vs. post) following 30 minutes of either types of TENS. Comparisons of the two types of TENS to the control group likewise elicited no change. Studies have reported analgesia in patients with pain following the application of TENS. It has been shown the cerebrospinal fluid endorphins have increased in chronic pain patients following acupuncture-like TENS. The present study did not show an increase in the pituitary endorphin pool, as measured in blood serum, following acupuncture-like TENS.

A POSSIBLE ROLE FOR MYOGLOBIN IN THE TRANSPORT OF FATTY ACIDS: ENERGY IMPLICATION IN EXERCISE.

K. S. Yackzan and W. J. Wingo. Diabetes Research and Training Center and Department of Biochemistry, University of Alabama in Birmingham.

It may be calculated on the bases of known values for various physical constants and other physiological parameters and a few assumptions that as much as 2/3 of the maximum total O_2 intracellularly transportable in myocardium and red skeletal striated muscle may be carried as oxymyoglobin (MbO_2), (This figure may be high).

Evidence exists that myoglobin (Mb) binds fatty acids, (FA). A possible binding site could comprise a cationic amino acid side chain to bind the fatty acids (FA) carboxyl group and an associated constellation of non-polar residues which could noncovalently bind the FA chain. On a Corey-Pauling model of Mb, we have found two sites that meet this criterion.

It is thus possible that in these two types of tissues, substantial fractions of a major fuel and its ultimate oxidizer are carried, intracellularly, by the same molecule.

Abstracts

COLD FOCUS FOR ISOELECTRIC FOCUSING: SEPARATION OF β -HEXOSAMINIDASE A AND B ISOENZYMES

J. T. Conary, B. Budowle, and J. N. Thompson, Lab. of Med. Genetics, DRTC, and Dept. of Biochem., Univ. of Ala. in Birmingham 35294.

Cold focusing, a novel method for performing isoelectric focusing was recently developed (Allen, Electrophoresis, 1:32, 1980). This method utilizes a beryllium oxide plate electronically cooled by two Peltier devices to disperse the heat from 160 μ m thick ultrathin-layer polyacrylamide gels (UTLG) during isoelectric focusing. Beryllium oxide dissipates heat with 200 times the efficiency of glass so that field strengths of 400-500v/cm and run times under 1 h are possible. In the present investigation the A and B isoenzymes of β -hexosaminidase, an enzyme important in lipid catabolism, were separated using the Cold Focus apparatus. Mechanical stability was achieved by covalently binding the UTLG to silanized glass plates. Isoenzymes A (pI 5.0) and B (pI 7.0) of β -hexosaminidase were visualized by staining the UTLG with 4-methylumbelliferyl-N-acetyl- β -D-glucopyranoside and viewing the stained gel with long wavelength ultraviolet light. The activity of the isoenzymes was quantified by cutting out the stained region of the gel, placing it in 1.5 mL of glycine-NaOH buffer, and measuring the fluorescence. When the enzyme was heated at 51°C prior to cold focusing the activity of hexosaminidase A isoenzyme was selectively destroyed; verifying that the activity found at pI 5.0 was the A isoenzyme. These studies demonstrate that cold focusing is a rapid and sensitive method for the separation of β -hexosaminidase isoenzymes A and B. Preliminary studies in our laboratory indicate that this method has application for separating the isoenzymes of several lysosomal acid hydrolases.

MONOCLONAL ANTIBODIES SPECIFIC FOR HERPES SIMPLEX VIRUS TYPE ONE MEDIATE ANTIVIRAL EFFECTS IN VITRO AND IN VIVO.

James Rector, Robert Lausch, and John Oakes. Dept. of Microbiology and Immunology, U. of South Alabama, Mobile AL 36688.

Ten hybrid lines secreting antibodies specific for HSV-1 infected cells were derived from four independent fusions. Eight of the ten lines were able to immunoprecipitate HSV-1 glycoproteins from detergent-solubilized infected cells. Seven of the eight monoclonal antibodies tested were effective in passively transferring immunity to mice when given 4 to 24 hrs. after HSV-1 infection of an abraded cornea. These results indicate that epitopes present on HSV-1 glycoproteins can initiate events leading to resolution of ocular infection. The monoclonal antibodies were also evaluated for their capacity to neutralize HSV-1 and to promote complement-mediated cell lysis or antibody-dependent cellular cytotoxicity. It was found that none of these in vitro assays correlated with the protective activity of the monoclones in vivo. On the basis of these results, it was concluded that HSV-1 specific glycoproteins can interact with antibody in vivo to initiate recovery from HSV-1 induced ocular disease and that the effectiveness of a specific monoclonal antibody to mediate recovery from ocular infection does not correlate with the immunological reactivity of the antibody in vitro.

ACID PROTEINASE ACTIVITIES OF THE NEMATODE *TURBATRIX ACETI*

Rajendra D. Ghai and Roger S. Lane, Dept. of Biochemistry, Univ. of South Alabama, Mobile, AL 36688

Two acid proteolytic activities, one that hydrolyzes [methyl-¹⁴C] hemoglobin to acid-soluble fragments and a second that hydrolyzes glutaryl-L-phenylalanine p-nitroanilide liberating p-nitroaniline, have been detected in the free-living nematode, *Turbatrix aceti*. These two proteases have been isolated from the 100,000 x g supernatant of *T. aceti* extracts by acid precipitation and gel exclusion chromatography, and separated from one another by affinity chromatography on diaminodipropylamine-pepstatin-Sepharose CL-6B. Proteinase B is not adsorbed to immobilized pepstatin in 0.2 M NaCl at pH 3.5 whereas Proteinase A is specifically bound under these conditions; elution of Proteinase A is achieved with 1 M NaCl at pH 9. Proteinase A has an apparent molecular weight of 70-75,000 (as estimated by gel filtration on a column of Sephadex G-100), is optimally active towards hemoglobin as substrate at pH 3, and is maximally stable at 4°C between pH 6 and pH 9. The enzyme is unstable in the pH range 2.0 to 4.5, losing 95% of its activity within 24 h. Pepstatin is a potent and instantaneous inhibitor of Proteinase A activity; 50% inhibition is obtained with 1.4 ng pepstatin. Non-denaturing polyacrylamide gel electrophoresis of Proteinase A purified by affinity chromatography shows the presence of two active protease components, indicating the occurrence of isoenzymic forms. Proteinase B is of Mr 75-80,000 and exhibits an optimum pH of 6.0 with glutaryl-L-phenylalanine p-nitroanilide as substrate. The enzyme also catalyzes the hydrolysis of azocasein, with pH opt = 5.0 to 5.5. The functional significance of these two proteases in intracellular protein degradation is not yet known.

IN VIVO METABOLISM OF TETRADEUTERO-INDOLEALKYLAMINES IN THE RAT

John M. Beaton, Philip E. Morris and Steven A. Barker, Neurosciences Program, Univ. of Ala. in Birmingham, Birmingham, AL 35294.

The uptake and metabolism of alpha, alpha, beta, beta-tetradutero-N,N-dimethyltryptamine (DDMT) in rat brain was examined using GC/MS-isotope dilution techniques. Adult male Long-Evans rats were injected IP with 2.5, 5.0 or 10.0 mg/kg DDMT. Three rats from each group were sacrificed at 5, 10, 20, 40 and 80 minutes post-injection. The brains were prepared for analysis, using proteo internal standards, as previously described (Biochem. Pharmacol. 29, 1049, 1980). An inverse relationship between the brain levels and dose of DDMT was observed at 5 minutes post-injection. The brain level of DDMT peaked at 5 minutes after 2.5 and 5.0 mg/kg and followed a dose dependent function while 10 mg/kg DDMT peaked at 20 minutes and did not correlate with the results seen at 2.5 and 5.0 mg/kg. DDMT was still detectable in rat brain at 80 minutes post-injection. The non-polar metabolites of DDMT were identified as deuterated tryptamine (TA), N-methyl-TA, tetrahydro-beta-carboline (THBC) and 2-methyl-THBC (2-MTHBC). The formation of NMT was well correlated with the brain level of DDMT. The TA and THBC were minor metabolites while 2-MTHBC was formed as a major end-product. (Supported in part by the Alabama Consumer Fund.)

Abstracts

STUDIES ON THE NEUROVIRULENCE OF HERPES SIMPLEX VIRUS

Wayne L. Gray and John E. Oakes, Dept. of Microbiology and Immunology, University of South Alabama, Mobile, Alabama 36688.

Strains of Herpes Simplex Virus (HSV) were found to differ greatly in their neurovirulence characteristics upon subcutaneous footpad inoculation into young adult mice. The viral dose required to kill 50% of infected mice was determined for five HSV-1 strains and two HSV-2 strains. LD 50s ranged from 10^4 to greater than 10^8 pfu. Virulent strains caused paralysis and a necrotizing encephalitis which resulted in death of the animals within two weeks. Avirulent HSV strains produced no clinically apparent symptoms. All of the HSV strains tested were virulent when inoculated intracerebrally. A pathogenesis study showed that a virulent HSV-2 strain replicates in the mouse footpad, travels to the spinal cord via the sciatic nerve, and then progresses to the brain. An avirulent HSV-1 strain also replicates in the footpad but virus was not detected in the spinal cord or brain. This suggests that the avirulence of some HSV strains is due to an inability to get from the site of infection to the central nervous system. No differences were seen in the ability of virulent or avirulent strains to replicate in mouse embryo fibroblasts in vitro. Since virulence is known to be a genetic characteristic of some HSV strains, intertypic recombinant viruses of virulent and avirulent strains are being tested in order to determine if a particular region of the HSV genome can be associated with viral pathogenicity. Preliminary studies indicate that the virulence of an HSV strain is determined by the long unique region of the genome. The eventual mapping of viral genes which are important in the enhanced virulence of some HSV strains could lead to a greater understanding of the pathogenesis of HSV infections.

A MUTATION AFFECTING LIMB DEVELOPMENT AND FERTILITY IN MICE

Kathryn Kartus, David Holladay, J. Russell Lindsey, and C.P. Dagg. Departments of Biology and Comparative Medicine, University of Alabama in Birmingham, Birmingham, AL 35294.

An inheritable condition that produces abnormalities of the appendicular skeleton has been discovered in C57BL mice. Mating tests support the conclusion that the genetic basis for the defects is an autosomal semi-dominant mutation with incomplete penetrance. The putative heterozygotes are characterized by pre-axial polydactyly on the hind feet. The presumed homozygotes manifest preaxial polydactyly on the forefeet and hind feet, dislocation of the hip (luxation), and a markedly shortened and narrowed tibia (tibial hemimelia). Male homozygotes appeared to be sterile in mating tests. Histological sections of the testes revealed seminiferous tubules that were smaller in cross section and almost completely devoid of cells. The mutation is provisionally called "swimmer," swm. The swimmer mutant closely resembles Green's luxoid. This research was supported in part by USPHS Grant No. RR-00463.

VITAMIN C AND THE COMMON COLD

Emmett B. Carmichael, Univ. of AL. in Birmingham

Linus Pauling's book, " Vitamin C and the Common Cold " which was published in 1970 stimulated scientists in many countries to test his hypothesis that Vitamin C could cure the Common Cold. In 1975, M.H.M. Dykes and P. Meier reported that they believed that there is little convincing evidence that daily doses of Vitamin C have any effect on the frequency or severity of the Common Cold.

During the late Sixties, arthritis in my fingers caused considerable pain and several of the joints were becoming enlarged. I began to take 500 mgm of Vitamin C twice per day in addition to a vitamin pill which contained 200 mgm of Vitamin C. By 1974 the pain in all of my fingers had been greatly reduced. My regular diet has been fairly rich in Vitamin C. In 1974 I increased the dose of Vitamin C to 1,000 mgm twice per day. In 1974 my wife, Marie began to take 500 mgm of Vitamin C twice per day in addition to a vitamin pill.

In addition to the fact that there is no arthritic pain in my fingers, neither my wife nor I have had a Common Cold since 1974. Our observations seem to refute those of Dykes and Meier concerning daily doses of Vitamin C on the frequency of the Common Cold.

ESTROGEN AND PROLACTIN DURING INTERVENTION FOR POOR LACTATION

Ellen B. Buckner and Larry R. Boots, University of Alabama School of Nursing and Dept. of Obstetrics and Gynecology, University of Alabama in Birmingham.

Nine women with poor lactation were followed to determine if milk production could be improved. Interventions included use of oxytocin nasal spray, use of the Lact-Aid Nurser® and adjunct breast pumping. Intervention used was determined by clinical indications and mothers' acceptance of intervention. Milk yield increased significantly in those mothers who worked to improve production but decreased in those who did not.

Prolactin (PRL) and 17- β estradiol were measured from blood samples taken before and after nursing. Prolactin values decreased as milk yield increased; thus improved milk production was not achieved by stimulating effect of PRL. Alternately as milk yield increased, estradiol decreased. This may be clinically significant since physiological levels of estradiol have been shown to inhibit PRL induced lactalbumin synthesis.

This research was supported in part by a Nursing Research Emphasis Grant for doctoral programs 1R21 NU00835 01, DHHS.

Abstracts

CHROMOSOME ANALYSIS AND TUMORIGENICITY OF THREE ISOLATED CELL LINES FROM A PRIMARY HUMAN COLON CARCINOMA

Jerome McCombs and Wayne Finley. Dept. of Physiology and Laboratory of Medical Genetics, UAB, Birmingham, AL 35294 and Michael Brattain. Dept. of Biochemistry, UAB, Birmingham, AL 35294.

Colonic carcinoma (CCA) is the second most frequent cancer in man ranking only below breast cancer in women and lung cancer in men. Some investigators have demonstrated apparent morphological and functional heterogeneity among cells in and between primary colonic carcinomas. Successful initiation of CCA cells in culture provides an opportunity to investigate the relationship between tumorigenicity and karyotypic findings. The primary tumor cells were set in culture on a feeder layer of an embryonic mouse cell line (C3H10T1/2). The CCA cells were removed from the feeder layer, continued in culture and then separated by density gradient centrifugation to yield 3 cell types. The cell lines OM, O and OFR were grown in culture and tested for tumorigenic response in nude mice by injecting with either 5×10^6 cells or 10×10^6 cells. These inoculums from cell lines OM, O and OFR were tumorigenic in 90%, 53% and 25% of the nude mice respectively. G-banded chromosomes from 50 cells were analyzed for each cell line. Cell line OM contained a normal karyotype of 46,XY. Cell line O was pseudodiploid (46,XY,18p+) while cell line OFR had a 47,XY,+8,13q+ karyotype. Three cell lines derived by culture of a CCA biopsy had different karyotypic findings and tumorigenic capabilities. This tumor heterogeneity may have implications in the therapeutic approaches taken in colon carcinoma treatment.

THE EFFECT OF ANTISTASIS FOOTBOARD EXERCISES ON SELECTED MEASURES OF EXERTION

William Ahrens*, Marguerite Kinney. Univ. of AL in Birmingham, Birmingham, AL., 35294. Rick Carter* Univ. of Texas at Tyler and Univ. of Texas Health Center, Tyler, Texas, 75701.

Cautions concerning the adverse consequences of isometric exercise in cardiac patients are based on prolonged isometric handgrip studies. To investigate the effects of prophylactic footboard exercises on heart rate (HR), blood pressure (BP), energy expenditure (EE), and perceived exertion (RPE), 15 normal subjects underwent randomly ordered exercise sequences using 50% of maximum voluntary contraction strength. Three isometric sequences (varying in contraction length) utilized a rigid footboard. A dynamic sequence utilized a spring-equipped movable footboard. No significant differences were observed in BP response or EE between the four activities ($p > .05$). Significant differences in HR and RPE were noted only between the dynamic activity and the isometric activity with the longest (60 second) sustained contraction duration ($p < .05$). The linear relationship between HR and RPE, previously demonstrated for strenuous activity, was not present in this study ($p < .05$). The assumption that footboard exercises are excessively stressful in coronary care patients needs to be re-evaluated. Prevention of thromboembolic complications in bedridden patients is of major concern to the practitioner and investigations of energy cost and cardiovascular stress associated with antistasis exercises assist in providing a rational basis for acute exercise prescription.

Abstracts

AUTORADIOGRAPHIC ANALYSIS OF L-[METHYL-³H]-METHIONINE IN HUMAN CELLS WITH FRAGILE SITE Xq2800

Kristin Mihelick. Dept. of Biochemistry, UAB, Birmingham, AL 35294.
Patricia N. Howard-Peebles. Dept. of Pathology, Cytogenetics
Laboratory, UTHSCD, Dallas, TX, 75235. Wayne H. Finley. Laboratory
of Medical Genetics, UAB, Birmingham, AL 35294.

A fragile site, a chromatid or chromosome gap or break, on the human X chromosome at Xq2800 has been associated with a form of non-specific X-linked mental retardation. Appearance of this site is dependent upon a culture medium relatively deficient in folic acid and thymidine and containing at least 5mg/L DL-methionine. To investigate the role of methionine in inducing the fragile site, L-[methyl-³H]-methionine was introduced at a concentration of 1mg/L (1.36µCi/ml) to a modified form of TC 199 lacking folic acid, thymidine, deoxyribose and DL-methionine. DL-Methionine was added at a concentration of 4mg/L. Peripheral blood from a mentally retarded male displaying the fragile site and a control male was cultured in this medium. After 24 hours 80% of the original medium was replaced with medium containing 5mg/L unlabeled methionine. Cultures were harvested after a total incubation time of 72 hours. Chromosome preparations following standard procedures for autoradiography were analyzed for developed grains over Xq2800 and a corresponding area on the No. 2 chromosome which served as a reference chromosome. No difference was detected in grain counts over the X chromosomes between individuals or in counts over the X and No. 2 chromosomes within an individual (p=0.01). This lack of difference suggests that another approach may be necessary to discern the role of methionine in inducing the fragile site.

URINARY TRACT CALCULI IN SPINAL CORD INJURY PATIENTS

M.J. DeVivo, A.B. McEachran, K.V. Kuhlemeier and P.R. Fine
Department of Rehabilitation Medicine, UAB, Birmingham, AL 35294

The purpose of this study was to determine the influence of select medical, epidemiologic and demographic variables on the development of urinary tract calculi in spinal cord injury (SCI) patients. The study was undertaken because SCI patients seem predisposed to the development of urinary tract calculi. **Bladder Calculi:** SCI patients who developed bladder stones were most likely to be young males with neurologically complete cervical lesions. Additionally, patients whose bladder management was either an indwelling urethral catheter or suprapubic cystostomy and who had a history of recurrent urinary tract infection (UTI) were at highest risk for the development of bladder calculi. **Renal Calculi:** Neurolevel and extent of lesion, history of recurrent UTI, bladder management via indwelling urethral catheter and a history of bladder calculi were important predisposing factors for the development of renal calculi. The predictive model for bladder calculi was 78% sensitive and 81% specific. The predictive model for renal calculi was 63% sensitive and 73% specific. While other determinants of urinary tract calculi development undoubtedly exist, it appears high risk patients can be identified using a small set of predictor variables.

Abstracts

INCORPORATION OF $[^{35}\text{SO}_4]$ INTO GLYCOSAMINOGLYCANS IN CULTURED FIBROBLASTS FROM PATIENTS WITH THE ZELLWEGER SYNDROME

E. Pointer Johnson, J.N. Thompson, and W.H. Finley. Laboratory of Medical Genetics, Univ. of Ala. in Birmingham, Birmingham, AL 35294.

Undersulfation of glycosaminoglycans (GAGs) has been reported in patients with Lowe's syndrome (Fukui *et al.*, J. Biol. Chem. 256: 10313, 1981), a disorder clinically similar to the cerebro-hepato-renal syndrome (CHRS) of Zellweger. In the present experiments, cultured skin fibroblasts from controls and two patients with CHRS were analyzed for sulfation of intracellular GAGs. Cells were grown in Ham F-12 medium + 10% FCS to deplete the sulfate prior to incorporating inorganic $[^{35}\text{SO}_4]$. Labeled GAGs were precipitated by hot ethanol, solubilized with NaOH, neutralized and measured (Cantz *et al.*, Methods Enzymol. 28:884, 1972). Initial studies revealed that incorporation of label was proportional to the concentration of $^{35}\text{SO}_4$ in the medium. Cultures were labeled for 6h, 12h, 18h and 24h with 4 μCi of $^{35}\text{SO}_4/\text{mL}$ medium (25×10^6 cpm/flask). Activity of $^{35}\text{SO}_4$ -GAGs in cpm/mg protein at each of those times for controls was 14,903; 21,189; 30,348 and 29,573; for CHRS the values were 19,957; 33,290; 35,648 and 40,478. Approximately half the label incorporated within 24h was present by 6h. Over 75% of the $^{35}\text{SO}_4$ -GAGs incorporated during a 48h pulse was eliminated from both control and CHRS fibroblasts following a 48h chase with unlabeled medium. In the present study no differences in the formation or loss of total $^{35}\text{SO}_4$ -GAGs between CHRS and control fibroblasts were apparent.

THE INSULIN RECEPTOR IN BOVINE CEREBRAL MICROVESSELS. Joyce Feh Haskell, Elias Meezan* and Dennis J. Pillion; University of Alabama in Birmingham, Birmingham, Alabama 35294.

The high incidence of microvascular disease as a long-term complication of diabetes mellitus may be related to a derangement in the metabolic control of vascular tissue by insulin. Binding of ^{125}I -insulin to isolated bovine cerebral microvessels was measured at 22°C for 75 minutes in the presence and absence of excess unlabelled hormone. Specific insulin binding has been characterized under various time, temperature and pH conditions in these isolated microvessels. Inhibition of insulin binding has been observed with various concentrations of unlabelled insulin, and Scatchard analysis of the data yields a curvilinear plot similar to that obtained with other tissues. Previous work in this laboratory has shown that incubation of cerebral microvessels with physiological doses of insulin cause an increase in several metabolic effects found to be insulin sensitive in other tissues. D-glucose oxidation and conversion to lipid and cyclic AMP phosphodiesterase activity were increased upon addition of insulin to isolated cerebral microvessels, demonstrating an intact hormone coupling system in vascular tissue. The current data verify the existence of a high affinity insulin receptor in cerebral microvascular tissue and demonstrate that this hormone receptor is similar in its binding characteristics to receptors found on other insulin-sensitive organs.

Abstracts

AN EXPERIMENTAL MODEL FOR THE STUDY OF SPINAL MENINGEAL LEUKEMIA

J. C. Kase, W. H. Wilborn, J. N. Varakis, L. B. Cheshire, and R. D. A. Peterson. Departments of Neurology, Anatomy, Pathology, and Pediatrics, and The Electron Microscopy Center, University of South Alabama, Mobile, AL 36688.

Syngeneic mice were injected intravenously with cells of "Line 13" of a T-cell lymphoma originally induced in C3H mice by Gross murine leukemia virus. The syngeneic mice developed lower paraparesis and sensory loss within 2-3 weeks after inoculation. The spinal cord showed an abundance of leukemic cell infiltrates in a consistent extradural location. The paravertebral muscles were also heavily infiltrated with leukemic cells. No leptomeningeal or parenchymal leukemic infiltrates occurred. Marked proliferation of leukemic cells in the bone marrow was always accompanied by spinal cord involvement. Visceral involvement tended to parallel the degree of bone marrow infiltration. The pattern of distribution of extradural and paravertebral muscular leukemic collections appeared to relate topographically to the proximity of heavily infiltrated bone marrow. Sites of communication between bone marrow and extradural infiltrates were repeatedly identified. There was no involvement of the leptomeninges or parenchyma, regardless of the severity of the extradural infiltration. On the other hand, "Line 13" cells injected directly into the brain produced diffuse leptomeningeal tumor cell infiltration without extradural involvement. These findings in the animal model suggest that the primary mechanism for extradural meningeal infiltration is by direct spread from the bone marrow. The animal model offers an opportunity to study malignancies that produce bone destruction as a mechanism for the spread of the tumor.

REAL VS IDEAL CONTENT IN MSN CURRICULA: PERCEPTIONS OF GRADUATES

Jeanette Lancaster. Sch. of Nursing, UAB, Birmingham, Al. 35294.

This study surveyed MSN graduates one year following graduation to determine their perceptions of what content was actually essential for their graduate education and what they believed ideally should have been required. It was the second study in a sequence in which faculty was surveyed as to their perceptions of actual and ideal essential content in their programs. There was considerable variability between the perceptions of faculty and graduates both about what was and what should have been included in the program. Additionally, graduates selected different content items for what was and what should have been included in their program. Of the top 12 items chosen as actual essential content, only five were retained as ideal essential content (research, methodology, change and nursing theory, and group and family dynamics). Graduates valued communication-oriented content areas more highly as ideally required than they perceived as being actually in their curricula. They ideally would have given high priority to conflict resolution and communication theory. Interestingly, graduates tended to want almost all items included in the curriculum. This may reflect their insecurity upon graduation and fear of being unprepared for work-related events.

Abstracts
CYTOMEGALOVIRUS INFECTION IN A DAY CARE CENTER

Anna M. August and Robert F. Pass, Department of Pediatrics, University of Alabama in Birmingham, Birmingham, Alabama 35294.

The prevalence of cytomegalovirus (CMV) excretion among children in a day care center was assessed in order to determine the effect of grouping young children upon transmission of CMV and to define the exposure to CMV experienced by female workers. Seventy of 75 (93%) children attending participated. Urine was obtained from 68 and mouth swabs from 33. Serum was available from 37 mothers and 16 employees. The children's ages ranged from 3 to 65 months; 94% were caucasian. Median age at entry to day care was 6 months; 59% had been breast fed. The mean number of siblings was 0.5, and parental ages were 29.4 ± 3 for mothers and 31.6 ± 4 for fathers. Parents averaged over 16 years of formal education. CMV shedding was found in 51% of children and was related to age:

Age (mo.)	0-12	13-24	25-36	37-48	49-50
+ve (%)	1/11 (9)	15/18 (83)	10/15 (67)	3/14 (21)	7/12 (58)

Nineteen of 37 (51%) mothers were seropositive; 25 (68%) of their children shed CMV. Excretion was not related to maternal serology or to breast feeding. Four of 36 excretors and 0 of 34 nonexcretors had experienced serious bacterial infection (2 meningitis, 1 bacteremia, 1 facial cellulitis), $p < 0.05$. Twelve of 13 (92%) children under 2 with viruria who were sampled at both sites were also positive in the mouth. CMV was isolated from 4 plastic toys mouthed by toddlers, suggesting a possible means of transmission. Ten of 16 workers were seropositive. Transmission of CMV among children in a day care occurs readily; virus excreting children may be a source of infection for employees and mothers.

ENERGY LEVELS IN THE INSTITUTIONALIZED AGED

Sarah Hall Gueldner, School of Nursing, The University of Alabama in Birmingham, Birmingham, Alabama 35294.

The sample consisted of 42 ambulatory subjects sixty years of age or older, including persons who lived in a nursing home, unemployed individuals who resided in a retirement village, and individuals employed part-time on a regular basis. A survey was made of sleep patterns, appetite, frequency of family contact, participation in group activities, and frequency of contact with the outside environment, including walks. Additionally, the Pearson-Byars Subjective Fatigue Checklist (PBSFC) was used to evaluate perceived energy levels in subjects, and electromyography (EMG) was used as a noninvasive measure of general metabolic activity. Following these initial measurements, the groups were randomly divided into a control group of nonwalkers and an experimental group of subjects who walked outdoors 3 mornings each week for a period of three weeks. Pre- and post-scores were statistically analyzed using analysis of variance, chi-square, regression, and student's t procedures. The results showed that residents of the retirement community walked outside more than did the residents of the nursing home, while nursing home residents slept better and reported better appetites ($P=.05$). Nursing home residents participating in the walking regime reported significantly increased energy levels ($P=.008$). These findings suggest inexpensive yet effective improvements that may be instituted in the care of elderly individuals living in nursing homes.

Abstracts

EXCRETORY UROGRAPHY FOR SPINAL CORD INJURY FOLLOW-UP

K.V. Kuhlemeier, A.B. McEachran, L.K. Lloyd, P.R. Fine and S.L. Stover
Department of Rehabilitation Medicine, UAB, Birmingham, AL 35294

This study was conducted to determine if excretory urography (EXU) is essential for follow-up care of spinal cord injured (SCI) patients with minimal pyelocaliectasis or ureterectasis. One hundred and fifty four patients were examined twice, generally 12 months apart. Of 63 kidneys with minimal pyelocaliectasis at first visit, 19 did not change, 37 improved and 7 worsened at the next exam. When all grades of pyelocaliectasis were combined, 218 kidneys did not change between exams, 44 improved and 46 worsened, 11 going from grade 0 (normal) or 1 (minimal pyelocaliectasis) to grade 2 (moderate pyelocaliectasis) or 3 (severe pyelocaliectasis). In each of these 11 cases other evidence, chiefly that obtained during renal scintigraphy, clearly indicated renal degeneration. Of 59 kidneys with minimal ureterectasis, 14 did not change, 41 improved and 4 worsened between visits. When all grades of ureterectasis were combined, 214 did not change, 46 improved and 46 worsened, 9 going from grade 0 or 1 to grade 2 or 3. Again other measures, chiefly renal scintigraphy, showed declining renal function in the latter 9 cases. Mean renal plasma flow as well as mean serum creatinine was the same for patients with normal EXU's and patients with minimal pyelocaliectasis or ureterectasis, giving further evidence of the ephemeral nature of minimal EXU changes in these patients. We conclude yearly EXU is unnecessary for SCI patients with minimal pyelocaliectasis or ureterectasis, provided x-rays of the kidneys, ureters and bladder and renal scintigraphy are used to monitor for calculi and renal function, respectively. However, any evidence of deterioration necessitates EXU to determine morphological alterations.

PROXIMITY RELATIONSHIP OF TROPONIN C

C.K. Wang, Frank Garland*, and Herbert C. Cheung*. Dept. of Biomathematics, Univ. of Ala. in B'ham, B'ham, AL 35294

In vertebrate skeletal muscle Ca^{2+} regulates the actin-myosin interaction by binding to troponin C (TNC), which is one of three subunits of troponin. This Ca^{2+} interaction induces conformational changes across the thin filament to bring about contraction. To investigate the Ca^{2+} effect we have determined the distance between two specific residues in TNC by fluorescence energy transfer. Dansylaziridine (DNZ) attached to Met-25 was used as the energy donor and 5-Iodoacetoamidoeosin (IAE) attached to Cys-98 as the acceptor. A transfer efficiency of 66% was obtained for Ca^{2+} free TNC and 81% for the fully saturated Ca^{2+} complex. From these results and depolarization data a range of donor-acceptor distance (R) was determined: 29-51, 26-51, and 26-51 Å for Ca^{2+} free TNC, half saturated, and fully saturated Ca^{2+} complexes, respectively. The lower bound of these ranges represents a more realistic estimate of the actual donor-acceptor separation. Ca^{2+} induces a 10% decrease in R and this small change suggests that no gross deformation of TNC is induced by Ca^{2+} binding. The fact that Ca^{2+} binding to two of the four sites (site 3 and 4) induces significant spectral changes of DNZ attached to Met-25 suggests that a molecular signal is transmitted over a distance of at least 29 Å. (Supported in part by AM-25193 from the NIH).

Abstracts

EFFECTS OF ABSORPTION AND SECRETION ON COLONIC LYMPH FLOW: A PHYSIOLOGICAL AND ANATOMICAL ANALYSIS

W. H. Wilborn, P. R. Kvietys, and D. N. Granger. Electron Microscopy Center and Departments of Anatomy and Physiology, University of South Alabama, Mobile, Alabama 36688.

The effects of net transmucosal fluid flux on lymph flow, lymphatic protein flux, and lymph oncotic pressure were analyzed in an isolated autoperfused canine colon preparation (*Gastroenterology* 81: 1080, 1981). Active fluid absorption and secretion were induced by intraluminal instillation of Tyrode's Solution alone and Tyrode's Solution containing 40 mM theophylline, respectively. In contrast to previous observations on the small bowel, colonic lymph flow, lymph protein flux, and lymph oncotic pressure were not affected by net transmucosal volume flux (absorptive or secretory). Ultrastructural analyses of the lymphatic and capillary microcirculations of the mucosal regions of the colon and ileum revealed that, relative to the small intestine, the colonic mucosa contained (1) lymphatic vessels of smaller caliber that did not extend beyond the basal one-third of the mucosa and (2) blood capillaries that were situated much closer to the epithelial cells (average juxtacapillary space: 1.9 μ m, ileum; 1.0 μ m, colon). These findings indicate that (1) the inability of net transmucosal fluid movement to alter colonic lymph flow is due to the paucity of lymphatic drainage in luminal two-thirds of the colonic mucosa and (2) blood capillaries are the sole conduits by which absorbed fluids are removed from the colonic interstitium. The latter task is facilitated by the close apposition of the fenestrated capillaries to the absorptive epithelium. (Supported by NHLBI 15680).

BLOOD PLASMA LEVELS OF CATECHOLAMINES, CORTISOL, AND ENDORPHINS IN MALE ATHLETES BEFORE AND AFTER 26, 6 AND 2 MILE RUNS

J. Dearman and K.T. Francis, Division of Physical Therapy, University of Alabama in Birmingham, Birmingham, Alabama 35294.

There is a growing awareness that opioid peptides called endorphins may represent a new class of neurotransmitters and modulators common to both central and somatic divisions of the nervous and endocrine systems. Endorphins appear not to function tonically but influence physiological processes selectively under specific environmental or endogenous conditions. One such condition--exercise--has been implicated as a stimulus for release of endorphins. The involvement of endorphins in exercise may be related to their role in the control of the hypothalamo-pituitary-adrenal axis. In order to further investigate this relationship under varying intensities of exercise stress, plasma endorphin, cortisol, and catecholamines were studied in 9 healthy marathon runners prior to and 15 minutes following a GXT, 26.2, 6, or 2 mile run. With the exception of endorphins during the 2 mile run, all three blood variables were significantly elevated when post-exercise levels were compared to pre-exercise levels. The percent increases in endorphins ranged from a low of 20% (2 mile run) to 132% following the 6 mile run. Percent increases in cortisol levels ranged from 22% (6 mile run) to 100% following the 26.2 mile run. Percent increases in catecholamines ranged from 130% (2 mile run) to 198% following the 6 mile run.

Abstracts

BEHAVIOR ASSESSMENT USING THE UAB SCALE

J.S. Richards, C.S. Nepomuceno, and M. Riles
Department of Rehabilitation Medicine, UAB, Birmingham, AL 35294

Pain as a subjective experience has been notoriously difficult to assess. However, the visible manifestations of pain, i.e. pain behavior, present a more feasible goal in terms of assessment. This abstract describes the conceptualization, design, development and evaluation of a scale for the quantification of pain behavior. The scale consists of 10 target behaviors: (1) verbal and (2) non-verbal complaints of pain, (3) downtime, (4) facial grimaces, (5) standing posture, (6) mobility, (7) body language, (8) use of visible supportive equipment, (9) stationary movement, and (10) medication intake. The scale has a 0-10 range. As employed in a formal Pain Clinic, it is quickly administered and has high interrater reliability ($r=.95$). A sample of 70 chronic pain patients were studied using the scale. Average pain behavior in the series was 5.4 on admission and 3.2 at time of discharge. The correlations between subjective reports of pain (0-10) and pain behavior scores were .16 at admission and .55 at discharge reflecting the discrepancy frequently observed between subjectively reported pain and its visible manifestations. Our experience with this pain behavior scale suggests that it is a quick, valid and reliable instrument which should prove useful as an objective measure of outcome in pain treatment programs. This should prove particularly to be the case in programs based on an operant model where the emphasis is on modifying pain behavior per se rather than subjective experience of pain.

EFFECT OF INCREASED EGG CONSUMPTION ON SERUM PHOSPHOLIPIDS

K. A. Blackwood. School of Arts and Sciences, Samford University, Birmingham, AL 35229. J. S. Dover and H. C. Elliott, Dept. of Clinical Laboratories, Baptist Medical Center Montclair, Birmingham, AL 35213.

The per cent of phospholipids present in serum was determined using a modified Folch phospholipid extraction method, thin layer chromatography, and transmittance densitometry. Twenty-three individuals were placed on an isocaloric diet, which included 4 eggs a day in addition to their normal egg intake. Serum samples were taken prior to and upon completion of the 8 to 12 week diet. The results showed that the mean differences ($\bar{X} \pm S.D.$) between the initial and final analyses were:

<u>Phospholipids</u>	<u>% Phospholipids</u>	
	<u>Baseline</u>	<u>Egg Study</u>
Lysolecithin	7.1 \pm 2.1	7.5 \pm 2.0
Sphingomyelin	23.4 \pm 4.0	23.1 \pm 3.5
Lecithin	59.9 \pm 3.7	59.6 \pm 2.7
Phosphatidylinositol	4.7 \pm 2.4	4.5 \pm 1.6
Phosphatidylethanolamine and Phosphatidylserine	4.9 \pm 2.2	5.3 \pm 2.5

None of these changes were significant at the 5% level. It is concluded that increased egg consumption does not appear to significantly change the level of serum phospholipids.

Abstracts

EFFECTS OF TESTOSTERONE PROPIONATE ON REGENERATION OF ACINAR CELLS IN SUBMANDIBULAR GLANDS OF RATS

J. L. Boshell. School of Dentistry, Medical College of Georgia,
Augusta, GA 30912

This report describes the effect of testosterone propionate (TP) on the histological appearance of the rat submandibular gland and rate of acinar cell mitoses following partial extirpation. Mature male Sprague-Dawley rats were anesthetized and a wedge was removed from the medial surface of the left submandibular gland. Beginning on the third day after the operation, the experimental animals were given subcutaneous injections of TP (100 μ g/animal) in sesame oil. Control groups were given subcutaneous injections of 0.1 ml sesame oil. Experimental and control animals were killed on 3, 5, 10, 15, 20, 25 and 30 days post-operation. Submandibular glands were removed and processed for light microscopic examination. To assess the level of mitotic activity, one thousand acinar cells were counted in two different areas and the number of mitotic figures was recorded. The histological appearance of the glands at each time interval was typical except that parenchymal components on the wound surface were smaller in size and there was evidence of lobule formation. The mitotic rate of acinar cells on the wound surface is normally high through 10 days. However following TP, the mitotic rate declines to near zero except day 10 when there is a rise. In controls, there is a suppression until day 15 and then a return to near zero. In the other area, mitotic activity was low at all time intervals. Thus it appears that these exogenous agents have a suppressive effect on acinar cell mitoses during the regenerative process in rat submandibular glands. Supported by NIDR Grant DE 05072.

WORK CAPACITY IN PARAPLEGICS

C.T. Huang, K.V. Kuhlemeier, A.B. McEachran and P.R. Fine
Department of Rehabilitation Medicine, UAB, Birmingham, Al 35294

Cardiopulmonary response in recently injured paraplegics performing continuous, intermittent and graded exercise was compared. The population consisted of 12 males with complete lesions between T-7 and T-12 and 7 normal male controls. Paraplegics performed 4.93, 4.89 and 4.95 watt-hours work; controls performed 4.98, 4.91 and 4.96 watt-hours work for each exercise respectively. Exhaled air samples were analyzed for $\dot{V}O_2$. Heart rate (HR) was monitored. $\dot{V}O_2$ and HR were highly correlated. Paraplegics demonstrated significantly higher HR ($p < 0.001$), respiratory quotients (RQ), and ventilatory rates ($p < 0.05$). There were no differences between $\dot{V}O_2$ and level of lesion among paraplegics. Graded exercise produced a significantly higher HR ($p < 0.001$) during the final data collection period but the mean HR for the total data collection period was lower than during continuous or intermittent exercise ($p < 0.01$). $\dot{V}O_2$ during graded exercise was higher ($p < 0.001$) during the last data collection period; however there was no difference in $\dot{V}O_2$ when compared with continuous or intermittent exercise. O_2 debt was significantly different ($p < 0.05$) between controls and paraplegics but did not differ between types of exercise with the exception of graded exercise which showed more O_2 debt than did continuous exercise ($p < 0.05$). In recently injured paraplegics, level of lesion and type of exercise significantly influence HR but not $\dot{V}O_2$ response.

Abstracts

PERITONITIS ASSOCIATED WITH PERITONEAL DIALYSIS A MECHANISM FOR SURVEILLANCE

Hala Fawal, Melissa Shelley*, Barbara C. Walker*, Barbara Hubbard*, and Geraldine W. Key*, University Hospitals, University of Alabama in Birmingham, Birmingham, AL 35294.

Peritoneal dialysis is a form of intracorporeal hemodialysis used to replace the function of damaged kidneys in certain patients with renal failure. This intervention requires the placement of an indwelling catheter into the peritoneal cavity. Peritonitis associated with this form of dialysis is an important problem which can be prevented. At the University Hospital, a concern existed as to the incidence of peritoneal dialysis-associated peritonitis and what could be done to fully assess the situation. Since incidence data were unavailable, the first priority was to devise a mechanism whereby an incidence rate could be established. In cooperation with the Nephrology Service, a form was developed for documentation and surveillance of peritoneal dialysis-associated peritonitis and a prospective incidence study initiated. The surveillance sheet will be completed by the peritoneal dialysis nurse. Information to be collected includes demographic characteristics, underlying renal disease and infection factors, as well as other potential risk factors. At periodic intervals, the data will be reviewed, statistically analyzed and then compared to non-cases to attempt to identify risk factors. Once the incidence rate is established, evaluation of procedures and comparison of experiences with other institutions will be facilitated. More importantly, this information will aid in the institution of effective preventative measures.

PSYCHOSOCIAL PREDICTORS OF DECUBITUS ULCERS IN SPINAL CORD INJURY

J.S. Richards, R. Meredith, P.R. Fine and C.S. Nepomuceno
Department of Rehabilitation Medicine, UAB, Birmingham, AL 35294

Recurrent decubitus ulcers are one of the most expensive complications of spinal cord injury (SCI) in terms of dollars spent for treatment as well as time lost from a potentially productive lifestyle. Decubitus ulcers are largely preventable, and clinical evidence and a few recent studies suggest that personality factors are often associated with their onset. The present study was an attempt to predict the presence or absence of decubitus ulcers post-discharge on the basis of psycho-social and demographic data gathered during the initial rehabilitation hospitalization. Data on the incidence of decubitus ulcers were gathered from SCI outpatients as part of another study. Four classes of predictor variables were used: medical, demographic, psychological and familial-social. Multiple linear regression techniques were used. The best set of predictors accounted for 50% of the variance ($r=0.71$) of the dependent measure presence or absence of decubitus ulcers. The occurrence of pressure sores was associated with younger age, a larger number of persons living in the household, higher verbal intelligence, lower ego strength, and more psychopathology as measured by the Minnesota Multiphasic Personality Inventory (MMPI). It was concluded that personality factors are associated with decubitus ulcer formation in SCI, and that such measures, gathered during rehabilitation, are helpful in predicting the post-discharge development of pressure ulcers...

Abstracts

EFFECTS OF A NEW LONG-ACTING STEROIDAL CONTRACEPTIVE ON BABOON ENDOMETRIUM

W. H. Wilborn, L. R. Beck, B. M. Hyde, and V. Z. Pope. Electron Microscopy Center and Department of Anatomy, University of South Alabama, Mobile, AL 36688. Department of Obstetrics and Gynecology, University of Alabama in Birmingham, Birmingham, AL 35294.

A major problem with long-acting injectable contraceptives such as medroxyprogesterone acetate (MPA) and norethindrone (NET) is irregular and unpredictable menstrual bleeding, varying from frequent bleeding and spotting to amenorrhea. Norgestimate (NGM), a new progestin, was studied for possible use as a long-acting injectable contraceptive. NGM was microencapsulated in a biodegradable polymer of polylactic acid and administered to three groups of normal cycling female baboons as predetermined by endometrial biopsies and radioimmunoassay of serum hormone levels. Each animal in a group (3-5 baboons/group) received a single intramuscular injection of one of the following doses of NGM: 5 mg, Group I; 25 mg, Group II; 50 mg, Group III. Endometrial biopsies were obtained for study by light and electron microscopy at intervals of 15-30 days for 8 months. The 5 mg dose did not inhibit ovulation, but the 25 mg and 50 mg doses suppressed ovulation for 3 months and 6 months, respectively, and maintained the endometrium in a pseudopregnant state without adverse effects. In the first month, stromal cells hypertrophied and epithelial cells regressed until they attained a stable, semiquiescent state which they maintained during the remainder of treatment. Irregular uterine bleeding was not observed with NGM, but it did occur with MPA and NET. The endometrium quickly regained its normal cyclicity and intricate structural-functional relationships essential for pregnancy following the end of the treatment period. It was concluded that NGM is a good candidate for use as an injectable, long-acting contraceptive.

EVALUATION OF TRAINING EFFECT FROM A CARDIAC REHABILITATION PROGRAM

Ann Clotfelter, Howard R. Horn, Baptist Medical Centers' Center for Health Promotion, Birmingham, Alabama 35209

To determine the effects of an exercise rehabilitation program, the comparative treadmill results and lipid profiles of 22 men and 2 women coronary heart patients who had completed a 12 week, 3 times per week, monitored exercise program under medical supervision were analyzed. Subjects had myocardial infarction (MI) and/or had coronary artery bypass grafts (CABG), angina alone or claudication. Ages ranged from 50 to 71 with a mean of 61.

Subjects were given a maximum graded exercise test (GXT) using the standard Bruce protocol and had a lipid profile before the initiation of the program and at its completion. Objective improvement was measured by duration of treadmill time and lipid changes.

The average improvement was a 50% increase in treadmill time with a range of 12 to 163%. HDL levels increased in 19/20 patients. Triglyceride levels decreased in 15/21 patients. Maximum heart rate increased in 22/24 patients. Submaximal double products (heart rate X systolic blood pressure) were lower on the second GXT at every stage in 22 of 24 patients.

The study demonstrated that an exercise program for coronary patients increases exercise tolerance and work capacity, while decreasing hemodynamic stress (\downarrow double products); decreases triglyceride levels, and elevates HDL. Subjectively the patients report increased feelings of well-being and self-confidence.

Abstracts

SOYBEAN TRYPSIN INHIBITOR PREVENTS ISCHEMIA-INDUCED DEHYDROGENASE TO OXIDASE CONVERSION

Ranjan S. Roy and Joe M. McCord. Dept. of Biochemistry, College of Medicine, University of South Alabama, Mobile, AL 36688.

It has been shown that xanthine oxidase exists *in vivo* as an NAD^{+} -reducing dehydrogenase and may be converted by various treatments *in vitro* to a superoxide-producing oxidase. In the rat intestine, this conversion occurs irreversibly and extremely rapidly *in vivo* during ischemia. The resulting burst of superoxide upon reperfusion is responsible for extensive post-ischemic tissue damage. Preliminary data indicate that this conversion occurs *in vivo* in the liver and heart although the kinetics in these tissues differ dramatically. No conversion was detected in rat skeletal muscle. The times required for 50% conversion of dehydrogenase to oxidase *in vivo* in non-perfused tissues of rats are as follows: intestine-4 sec., heart-300 sec., and liver-3600 sec.

A Ca^{2+} -calmodulin regulated serine protease appears to be the major cause of the conversion to oxidase in the rat intestine. Pretreatment with trifluoperazine (200 mg/kg ip), a calmodulin antagonist, significantly slows the rate of this conversion *in vivo*. Soybean trypsin inhibitor (25 mg/kg) completely blocks the intracellular dehydrogenase to oxidase conversion in intestinal cells brought about by ischemia. Soybean trypsin inhibitor, due to its size, is unlikely to penetrate the cell membrane. Its mechanism of action is therefore hypothesized to be mediated via a trypsin-like receptor on the mucosal cell surface which is activated by ischemia. (Supported by grants AM-20527 and AM-00595 from the NIH.)

EFFECT OF ENZYMATICALLY GENERATED SUPEROXIDE RADICALS ON INTESTINAL CAPILLARY PERMEABILITY.

Dale A. Parks and D. Neil Granger, Dept. of Physiology, Univ. South Alabama, Mobile, AL 36688.

Recent evidence indicates that superoxide radicals may account for the increased vascular permeability associated with various disease states including intestinal ischemia. In order to determine whether enzymatically generated superoxides were capable of producing increased capillary permeability, the steady-state relationship between the lymph to plasma protein concentration ratio (C_L/C_P) and lymph flow was used as an estimate of capillary permeability. Lymph flow and C_L/C_P were measured at various venous pressures and the osmotic coefficient (σ_d) estimated using $\sigma_d = 1 - C_L/C_P$ when C_L/C_P is filtration independent. Autoperfused segments of cat ileum were subjected to intra-arterial infusion of hypoxanthine-xanthine oxidase, a superoxide radical generation system. The osmotic reflection coefficient obtained ($\sigma_d = 0.65$) was in the range between normal values ($\sigma_d = 0.92$) and estimates following 1 hr. of regional ischemia ($\sigma_d = 0.59$). These findings, coupled with results from previous studies from our laboratories, suggest that superoxide radicals are responsible, at least in part, for the increased capillary permeability in the ischemic small bowel.

Abstracts

MORPHOLOGICAL STUDIES OF KERATOHYALIN GRANULES OF MAMMALIAN TONGUES

Baldev Singh, Jerry Boshell, and Dave Steflik. Department of Oral Biology, Medical College of Georgia, Augusta, GA. Walter Wilborn. Department of Anatomy, University of South Alabama, Mobile, AL.

During the past few years our laboratories have employed a systematic approach in the study of oral epithelial cell differentiation. One of the major aspects of these investigations has been to elucidate the biological composition and role of keratohyalin granules (KHG) during keratinization. For this purpose we have studied the tongue KHG of five Orders of mammals including Primates, Rodents, Artiodactylia, Carnivora, and Lagomorpha. The tissues from the dorsal surface of tongue were subjected to analysis employing light microscopic histochemistry, electron microscopy and, in some cases autoradiography. Based on their staining with hematoxylin and/or eosin, KHG can be classified as basophilic (BKHG), eosinophilic (EKHG) and amphophilic (AKHG). All three types of KHG are comprised primarily of protein(s). The dominant protein component of the various KHG are as follows: the BKHG, histidine-rich proteins; EKHG, arginine-rich proteins; and AKHG, both histidine and arginine containing proteins. Ultrastructurally, KHG are dispersed in the differentiating epithelial cells rendering an electron dense background to the fully keratinized cells. However in some cases the EKHG were noted at the cell periphery and such epithelial cells appeared rather electron-lucent in nature. The current investigations show that KHG are heterogenous in their biological composition and morphology. Nevertheless they seem to play an important role in the final process of epithelial cell differentiation and produce different types and/or degrees of keratinization.

THE EFFECTS OF CHEMICAL CONTRACEPTION ON PLASMA VITAMIN LEVELS AND
SELECTED COENZYME-DEPENDENT ENZYME ACTIVITY IN FEMALE BABOONS

L.R. Boots and P.E. Cornwell*. Dept. of OB/GYN and Nutrition Sciences*, UAB, University Station, Birmingham, AL 35294

Vitamins A, B₆, B₁₂, C, folate, riboflavin, thiamin and β -carotene were measured in the blood of 10 female baboons during normal menstrual cycles and while being treated for one year with either Lo-Ovral or Depo-Provera. During normal menstrual cycles, vitamin C levels were highest early in the cycle ($P < 0.01$), β -carotene levels were elevated late in the cycle ($P < 0.05$) and vitamin A was lowest at midcycle ($P < 0.05$). Plasma levels of folate and vitamin B₁₂ and the enzyme indicators of vitamin B₆, riboflavin and thiamin status did not change during the menstrual cycles. Vitamin A and β -carotene levels were significantly lowered by treatment with Depo-Provera while both treatments increased vitamin C levels. Vitamin B₆, riboflavin and thiamin status were all altered by contraceptive treatment, showing variously changed levels and significant cyclical patterns. Supplementation with vitamins B₆, riboflavin and thiamin during the last 16 weeks of treatment variously affected these latter three vitamins as well as vitamin A, C and β -carotene levels ($P < 0.01$).

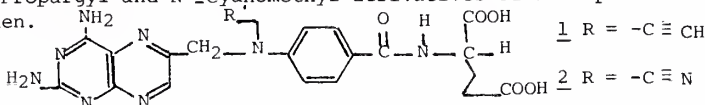
Supported by NICHD Grant #R01 HD10768.

Abstracts

INHIBITORS OF THYMIDYLATE SYNTHASE OF THE COENZYME CLASS.

M. G. Nair, College of Medicine, University of South Alabama, Mobile, AL. 36688.

Thymidylate synthase (TS) catalyses the terminal step in the *de novo* synthesis of thymidine nucleotides required exclusively for DNA synthesis. Because of this unique feature of the enzyme it continues to be a prime target for cancer chemotherapy. Although potent inhibitors of TS of the substrate class are well known, inhibitors of TS belonging to the coenzyme class have not yet been developed with the exception of the recently reported antileukemic agent, 5,8-dideaza-N¹⁰Propargyl folic acid. Based on this, and a newly proposed mechanism of thymidylate synthesis [Nair, Fed. Proc. (1982)] the synthesis and antitumor evaluation of N¹⁰Propargyl and N¹⁰Cyanomethyl derivatives of aminopterin were undertaken.

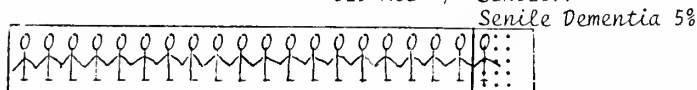


Alkylation of diethyl p-aminobenzoyl-L-glutamate with Propargyl bromide and α-bromoacetone gave the corresponding monoalkylation products, which were reacted with 6-Bromomethyl-2,4-diamino pteridine. The resulting diethyl esters were hydrolyzed to their respective acids 1 and 2; and were purified by ionexchange chromatography over DEAE cellulose. As expected both 1 and 2 were good inhibitors of L-Casei dihydrofolate reductase, and inhibited the growth of folate requiring microorganisms (L-Casei and S. Faecium). These activities were comparable to those of methotrexate. The Propargyl derivative 1 was ten times more potent an inhibitor of L-Casei TS than methotrexate. However compound 2 was not an effective inhibitor of this enzyme. Support: CA 27101 from NCI.

ALZHEIMER'S DISEASE (AD) : BIOLOGICAL ENTITY - SOCIAL IMPACT

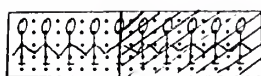
Geraldine M. Emerson and Elizabeth W. Murray, Center for Aging and Department of Biochemistry, University of Alabama in Birmingham, University Station, Birmingham, AL 35294

OLD AGE ≠ SENILITY



Americans, 65⁺ years

Alzheimer's Type



Dementia 55%

Demented Americans, 65⁺ years

Although Dr. Alois Alzheimer described this disease in a 51 year old patient in 1906 we are still unable to translate the neuropathological changes into the manifestations of AD. AD is best recognized by a sequence of behavioral changes starting with memory impairment and progressing to loss of cognitive functions. Women appear to be slightly more susceptible to the disease than men. It appears that some cases of AD are genetic; others of environmental etiology. Regardless, on autopsy all brains show abnormal enlargement of cell bodies densely packed with neurofibrillary tangles which displace mitochondria and other organelles. Society has yet to focus on the burden that AD imposes on the patient's family.

Abstracts

HISTOLOGICAL OBSERVATIONS ON THE EFFECTS OF ISOPROTERENOL AND/OR TESTOSTERONE PROPIONATE ON REGENERATION OF RAT SUBMANDIBULAR GLANDS

Jerry L. Boshell, and Baldev Singh, School of Dentistry, Medical College of Georgia, Augusta, GA 30912.

Studies on regeneration of submandibular glands of rats are ongoing in our laboratories. The purpose of this report is to compare the effects of isoproterenol (ISO) and/or testosterone propionate (TP) on the histological appearance of regenerating tissue following surgical removal of a portion of the left submandibular gland. Male Sprague-Dawley rats, 325-350 grams in weight, were anesthetized and a wedge was surgically removed from the medial surface of the left submandibular gland. Beginning on the third day after the operation, the animals were injected with ISO (16 mg/kg) in saline and/or TP (100µg/animal) in sesame oil. Control groups were given injections of saline and/or sesame oil. Appropriate experimental and control animals were killed on 5, 10, 15, 20, 25 and 30 days postoperation. Submandibular glands were removed, fixed in formalin and processed for light microscopic examination. In controls, buds of tissue appeared on the cut surface by 5 days, and by day 15 foci of tissue with the appearance of newly forming lobules was observed. After ISO, little regenerating tissue was observed and a pronounced void was present at the surgical site. With TP, the histological appearance was similar to controls at all time intervals. With both ISO and TP the differentiation of the regenerating tissue appeared to be more advanced from 15 days on. Thus, it appears that in combination ISO and TP enhances the histological differentiation of regenerating tissue. Supported by NIDR Grant DE05072.

NON-CORRELATION BETWEEN SERUM CREATININE AND RENAL FUNCTION

K. V. Kuhlemeier, A. B. McEachran, L. K. Lloyd, P. R. Fine
and S. L. Stover

Department of Rehabilitation Medicine, UAB, Birmingham, AL 35294

This study was conducted to determine (1) if serum creatinine values in spinal cord injury patients are influenced by neurologic level of lesion or time since injury and (2) if serum creatinine values are a sensitive indicator of renal function (as reflected by renal plasma flow and parenchymal thickness) in these patients. Renal plasma flow was measured by ^{131}I -hippurate clearance and mean parenchymal thickness was determined from excretory urograms. The overall serum creatinine mean and standard deviation were 0.9 ± 0.2 mg/dl ($n=14$). There was no difference in serum creatinine values with lower injuries (T7 or below) nor was there any difference between patients with lesions < three months, 10-14 months or 33-36 months in duration. Age and gender each accounted for less than 5% of the variation in serum creatinine. There was no significant correlation between renal plasma flow and serum creatinine (unless the patient had moderate or severe pyelocaliectasis or ureterectasis) nor between change in renal plasma flow (from the previous examination, usually 12 months earlier) and change in creatinine. Likewise, there was no significant correlation between parenchymal thickness and serum creatinine nor between change in parenchymal thickness and change in serum creatinine. We suggest that serum creatinine levels are relatively insensitive indicators of renal function in spinal cord injured patients.

Abstracts

ALTERED CHLORIDE TRANSPORT IN THE IN VITRO GASTRIC MUCOSA

Richard L. Shoemaker, Department of Physiology and Biophysics,
University of Alabama in Birmingham, Birmingham, AL 35294

The effects of inhibitors (DIDS, Furosemide, and Ethacrynic acid) on the Cl^- transport mechanisms were studied using frog gastric mucosae. The acid secretion rates, Cl^- flux, potential difference, resistance and short circuit current were measured. DIDS (4,4'-Diisothiocyano-2,2'-Disulfonate) when added to the serosal bathing solution (2 mm), reduced the acid secretion rate, reversed the polarity of the potential (P.D.), reduced the Cl^- flux from serosa to mucosa (but the Cl^- flux was not reduced as much as the H^+ rate) and reduced the net Cl^- flux; the transmembrane resistance was not changed after DIDS. In mucosae not secreting acid or in antral mucosae, DIDS reduced the P.D. only to zero. Furosemide had effects similar to DIDS. Neither the DIDS or Furosemide effects were reversible. In experiments where DIDS was followed by Ethacrynic acid (on the mucosal side) the H^+ rate and the P.D. were decreased to zero, and the resistance also decreased. Ethacrynic acid also produced a reduction in the resistance of the antral mucosae. Therefore, the effort of Ethacrynic acid was not restricted to the oxyntic cells. The reduced H^+ rate after DIDS probably was due to a change in intracellular pH after the $\text{HCO}_3^- - \text{Cl}^-$ exchange was inhibited. The reversal of the P.D., after DIDS, could be due to unmasking of the H^+ EMF as the Cl^- transport rate was reduced. The reduction in Cl^- flux without a change in resistance suggest that DIDS alters a non-conductive Cl^- transporting pathway.

MORPHOLOGICAL OBSERVATIONS ON THE AMPHOPHILIC GRANULES OF LAGAMORPH TONGUE FILIFORM PAPILLAE

Baldev Singh, Jerry Boshell and Ralph McKinney. Department of Oral
Biology, Medical College of Georgia, Augusta, GA 30912

The objective of this investigation was to characterize morphology of the filiform papillae and biostructure and biological composition of keratohyalin granules (KHG) of Lagamorph tongue. For this purpose tissues from various dorsal sites of the tongues of ten adult rabbits were studied by light microscopic histochemistry, scanning and transmission electron microscopy. The rabbit tongue revealed the presence of three types of filiform papillae. These have been designated as: type I (short and thick located anteriorly), type II (long and slender located in the midzone) and type III (intermediate size located posteriorly). Each type of papilla was comprised of an anterior and a posterior cell line. The anterior cell line differentiated in the presence of KHG which exhibited varied electron morphology. The KHG stained with hematoxylin as well as eosin, thus denoting their amphophilic character. Histochemically these KHG reacted both with Sakaguchi Oxine reaction (arginine-rich proteins) and Pauly's reagent (histidine-rich proteins). The tinctorial properties and histochemical characteristics distinguish the rabbit tongue KHG from the classically described basophilic KHG which contain histidine-rich protein(s) as the dominant moiety and the recently described eosinophilic KHG comprised primarily of arginine containing proteins. A marked regional variation in the morphology as well as elucidation of amphophilic granules in the rabbit tongue filiform papillae are the first reported observations in literature to our knowledge.

Abstracts

DETERMINANTS OF SATISFACTION IN THE PHYSICIAN-PATIENT RELATIONSHIP

W. H. Fite, University of Alabama School of Nursing, Birmingham, AL 35294 and S. C. Fite, St. Vincent's Hospital, Birmingham, AL 35201

This study explored determinants of patient satisfaction in physician-patient relationships by soliciting opinions regarding factors affecting satisfaction and self-assessments of satisfaction from persons engaged in such relationships. A split sample of 28 student nurses (24 female, 4 male, 23 white, 5 nonwhite, age 25.6 ± 5.5) and 29 lower-middle SES adults (18 female, 11 male, 29 white, age 35.2 ± 10.8) completed a 60 item questionnaire which assessed satisfaction with present relationship and rated present and ideal relationships on 10 parameters of satisfaction. Response differences between subgroups were minimal. Using all cases, multiple linear regression indicated that 74% of variance in mean reported satisfaction was explained by variables describing actual relationships and 68% by those describing ideal relationships. Multiple discriminant analysis correctly classified 87.3% of subjects as satisfied or unsatisfied using actual descriptors and 96.3% using ideal descriptors. Of 10 parameters, information-giving, helpfulness, and clinical progress ranked most important; friendliness, carrying out of medical orders, and barriers to treatment as least important. Results must be interpreted with caution but suggest implications for building effective therapeutic relationships. Several theories widely applied in health care including Parsons' social interaction theory and Orem's self-care model are not supported. Low rankings accorded to compliance with physicians' orders questions the usefulness of this concept as a measure of success in therapeutic relationships. Results should be confirmed with randomly-selected subjects.

ANTHROPOLOGY

INDIVIDUALISM AND COOPERATION AMONGST THE SADAMA

John Hamer, Dept. of Anthropology, University of Alabama in Birmingham, Birmingham, AL, 35294.

This paper suggests that the relationship between individualism and cooperation has always been a problem amongst the Sadama. A relative balance has been maintained not simply on the basis of an altruistic mutuality, ritual, or informal sanctions, but through the tangible authority and sanctions provided by councils of elders. The authority of the latter has been reinterpreted to fit the executive committees of peasant associations in controlling the potential for individual self-aggrandizement in the cash economy. Such personalized social control appears to be more effective in providing for cooperation within associations than that provided by impersonal state controls.

Abstracts

AN ECOLOGICAL APPROACH TO INTERNAL MIGRATION IN THE U.S.

Henry Inman, Dept. of Biostatistics, Univ. of Alabama in Birmingham, Birmingham, AL, 35294.

Commonly demographers use estimates of net birth and net migration rates in their analyses of population growth. Instead consider the growth in the absolute size of sub-populations defined so that these populations reflect the results of net natural increase and net migration. In a given state, the size of the population of persons born in that state reflects the birth rate, while the size of the population of persons born outside that state represents the result of migration to the state of interest. An approach analogous to the ecological analysis of animal populations permits us to examine simultaneously the interaction of birth in and migration to a particular state by looking at the changing sizes of these populations between 1870 and 1970 in the states of Alabama and Illinois: whites born in the state, nonwhites born in the state, whites born in another state, nonwhites born in another state, and those persons born outside the United States. One advantage of the ecological framework is that we can examine how the migration of one group, persons of foreign birth, for example, depended on the birth rates of whites and nonwhites in a given state by determining how the growth of the foreign-born population in that state was related to the growth of the population of native whites and native nonwhites. Furthermore, by comparing the "population ecologies" of states like Alabama and Illinois, we can trace the different patterns of population growth in the various regions of the United States during the last century.

MORPHOLOGICAL VARIABILITY AND DOMESTICATION

Brian Hesse, Dept. of Anthropology, University of Alabama in Birmingham, Birmingham, Alabama, 35294.

The domestication of animals has two main cultural facets -- animal taming and animal management. Each facet is usually coupled with a series of specific criteria, recognizable in the archaeological record, that permit its documentation in the past. An important one of these, usually associated with taming, is the size diminution of domestic stock compared to their wild ancestors. This criterion is evaluated using samples excavated from the early neolithic site (ca. 8000-7000 B.C.) of Tepe Ganj Dareh in west-central Iran. Three conclusions are drawn. First, size diminution is an "old news" record of taming. Several generations of domestic stock must have existed before the effects are clearly visible. Second, the size diminution often recorded from ancient Near Eastern sheep and goat samples is more likely due to a shift in the proportions of males and females in the samples than species wide size diminution. Third, osteometric data can better be used to estimate the relative proportions of the sexes in the populations of animals slaughtered at different ages.

Abstracts

CLIMATE CHANGE IN ANCIENT COASTAL ISRAEL

Paula Wapnish, Dept. of Anthropology, Smithsonian Institution, Washington, D.C., 20560

It has recently been argued that no significant climate change affected the occupations of coastal Israel during the second and first millennia B.C.E. Further, it has been suggested that the remains of small animals, while species sensitive to environmental changes, are inaccurate archaeological records of climate because of the multitude of factors that can account for their presence in an ancient site. The faunal samples from the site of Tell Jemmeh, a Chalcolithic to Hellenistic occupation located on the Wadi Besor not far from Gaza, challenge these conclusions. Remains of birds found at the site (more than 27 species) indicate a trend toward more arid conditions in the catchment of the site through the 2nd millennium B.C.E. This record is corroborated by the relative frequencies of pigs, gazelles, hartebeeste, fallow deer, and camels, and suggests that climate cannot be ruled out as a factor in the political instability that marked the end of the Bronze Age in the region.

CLANS, COURAGE AND COMMERCE: CHEROKEE LEADERSHIP SELECTION

Jaynn Kushner, Dept. of History, University of Alabama in Birmingham, Birmingham, AL, 35294.

An examination is made of the sequence of leaders and political forms between 1730 and 1839 in order to discover the changes which occurred over time in the process of leadership selection. From these records a conclusion is drawn that the following sequence of phases developed over the period in question: the Kinship Phase, the Military Phase, and the Mixed-blood Phase, each with its distinct set of leadership criteria. In the Kinship Phase leaders were selected on the basis of hereditary religious rank. In the Military Phase selected centered upon leadership ability demonstrated in warfare. In the Mixed-blood Phase leaders were selected on the basis of commercial and diplomatic skills. The balance of the paper considers both the nature of the above changes, and epidemic disease, trade and a diminishing land-base as sources of change. It is concluded that the variations in leadership selection reflect shifts in tribal values and priorities brought about by changes in the material environment resulting from white contact.

Abstracts

PHARMACISTS AND OTC'S IN THE URBAN MEXICAN HEALTH CARE SYSTEM

Kathleen Logan, Dept. of Anthropology, Univ. of Alabama in Birmingham, Birmingham, AL, 35294.

The study, done in Ciudad Juarez, Chihuahua, Mexico shows the importance of OTC's (over the counter medications) and pharmacists in the health care system of urban Mexico. OTC's were found to be the most widely used form of self-medication. Pharmacists were found to be the most frequently consulted health care practitioners. Pharmacists are consultants about OTC's. In particular, pharmacists recommend particular medications, give cost-benefit analyses of various medications, and basic information about OTC's, which enable people to choose among similar products. Pharmacists are also diagnosticians when physicians are not available. People prefer OTC's and pharmacists for several reasons. Self-medication with OTC's and pharmacists is less expensive than using the other health care options and more convenient. Also it enables individuals to retain control over their own treatment. The dangers of this kind of health care and future research about it are also discussed.

ZOOARCHAEOLOGICAL INVESTIGATIONS AT TELL EL-HAYYAT, JORDAN

Mary C. Metzger, Dept. of History, Univ. of Alabama in Birmingham, Alabama, 35294.

Tell el-Hayyāt is a Bronze Age village site located in the Jordan Valley about 40 km. northwest of Amman. The site is of significant archaeological interest because evidence suggests that its occupation spans from the latter stages of the Early Bronze Age to the Middle Bronze Age (ca. 2300-1700 B.C.). Many researchers have regarded this period as one which exhibits a gradual transition from pastoral to urban living patterns. Zooarchaeological analyses play a large role in determining more closely the nature of subsistence during this period. Economic conditions are indicated by the relative proportions of food animals, both wild and domestic. These proportions further suggest environmental factors which acted to constrain husbandry and marketing decisions. Climatological shifts are also attested by microfaunal remains. Rodents and birds are particularly responsive to such shifts.

Abstracts

BOTTLES FROM THE BLUE MUD SITE, BIRMINGHAM, ALABAMA

Nancy Boice, Dept. of History, Univ. of Alabama in Birmingham, Birmingham, AL, 35294.

The Blue Mud Site is a stratified refuse dump located in Birmingham, Alabama. The site was in use from the 1890's to the 1950's. This paper examines bottles from the local dump in order to date the site and to document the social and economic trends present in Birmingham around the turn of the century. The earliest bottles are medicine and panel bottles that contain medicinal products. These products came to Birmingham primarily from the northeastern United States. Of younger age and in most abundance are soda water bottles. These bottles are of local origin.

THE EVOLUTION OF COPULATORY CALLS IN MACACA FASCICULARIS

Bruce Wheatley, Dept. of Anthropology, Univ. of Alabama in Birmingham, Birmingham, AL, 35294.

The theory of sexual selection emphasizes the role of male dominance in mating success as an important cause in the evolution of polygyny. A twenty-month study on wild macaques in Indonesian Borneo revealed that the potential role of females in controlling mate quality had been overlooked. One way a female may affect the quality of her mate is to advertise her sexual receptivity by giving an individually recognizable staccato call unique to copulation. Data are presented to support the proposed hypothesis that the advertisement function of these copulatory calls is to incite male-male competition. Research was supported by NSF Grant BSM 74-14190; The Explorers Club; and a Sigm Xi Grant-in-Aid of Research

GEOLOGICAL INTERPRETATION AIDS ARCHAEOLOGICAL SITE LOCATION

Philip Stroud. Dept. of Geology and Norman Bayne Cranford, Auburn University, Auburn, AL 36849.

Wilcox County is in the Gulf Coastal Plain. The Northern tenth, about 90 square miles, is within the outcrop area of Cretaceous formations and the southern nine-tenths is within the outcrop area of Tertiary formations. Quaternary flood-plain and terrace deposits border the Alabama River and its larger tributaries. The archaeological site being investigated is within the Alluvial deposit area of the Alabama River Quaternary flood-plain, and rock types consist of angular to rounded quartz, cherts and quartzite gravel. Sedimentological research, grain analysis study, is continuing in the area in an attempt to locate ancient river meanders. There appears to be a connection between ancient river meanders and sites of early indian habitation.

MINUTES

ALABAMA ACADEMY OF SCIENCE
ANNUAL BUSINESS MEETING
University of Alabama in Birmingham
Birmingham, Alabama
March 19, 1982

Agenda

1. Call to order by the President
 2. Report of Counselor to the A.J.A.S.
 3. Report of State Coordinator of Science Fairs
 4. Report of Gorgas Foundation
 5. Report of the Secretary
 6. Report of Place of Meeting Committee
 7. Report of the Resolutions Committee
 8. Report of the Research Committee
 9. Report of the Auditing Committee
 10. Nominating Committee Report
 11. New Business
- 1) Dr. Kenneth Ottis, President of the Academy, called the meeting to order at 1:35 p.m. He expressed thanks to the officers, committees and membership for their services during the past year. He called upon the membership to look confidently to the future and to redouble their efforts in moving the Academy toward its goals. Dr. Ottis then asked for the report of the Counselor to the AJAS.
- 2) Dr. Gene O'Masta reported that the Alabama Junior Academy of Science was still in the midst of its program and that a final report would be forwarded to the Secretary at a later date. However, Dr. O'Masta presented the following preliminary information.
- a) Approximately 350 students from across the state have participated in this year's meeting. Approximately 300 of these students will attend the banquet.
 - b) Approximately \$1800.00 has been raised for the AJAS through the sale of liquid handsoap.

(Secretary's note: The following final report of the Counselor to the AJAS has been forwarded to the Secretary for inclusion in the minutes.)

The 1982 annual meeting was hosted by the University of Alabama in Birmingham and like all previous symposia, was shared with the Alabama Academy of Science.

Minutes

For the second year in a row, the scientific paper competition was a part of the annual symposium. Winners were:

Physical Science	1st Place Gary Griner	Huntsville High
	2nd Place Michelle Slay	Huffman High
Biology	1st Place Clark Baker	Tuskegee High
	2nd Place Catrina Leonard	Kinston High
Humanities	1st Place Keith Miller	Opp High
	2nd Place Marsha Worley	Opp High
Engineering	1st Place Vachel Lovvorn	Dothan High
	2nd Place George McGlammary	Bradshaw High
Mathematics	1st Place Ralph Ball	Auburn High
	2nd Place Greg Mount	Childersburg High

Other awards were:

AAAS - A subscription to Scientific Monthly and Science Newsletter

Mary Madison	Escambia County High
David Tinsley	Childersburg High

Research - \$50 for a research project

Lana Hagel	Huffman High
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Archaeological Dig - \$100 for summer Dig sponsored by the University of Alabama

Rachel Pierce	Escambia County High
Michael Osborne	Bradshaw High
Jamie Bailey	Lynn High
Tammy Denise Roberts	Mary G. Montgomery High

Liquid Soap - \$100 for the school which sold the most liquid soap

Opp High	Sponsors	Elsie Spencer
		Barbara Reynolds

Outstanding Teacher (more than five years) - \$100

Jane Nail	Escambia County High
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Outstanding Region - A Trophy is passed on from last year's recipient

South Region	Counselor Dr. Lou Destito
--------------	---------------------------

Minutes

Newly Elected Officers for 1981-82:

President	Michael Grubbs	Resource Learning Center
Vice President	Destry Hardin	Athens High School
Treasurer	Tom Anderson	Athens High School
Secretary	Carl Jones	Resource Learning Center

Many persons deserve a special thanks for their efforts in support of the symposium, including: Ms. Ellen Buckner for work as coordinator of AJAS activities in arranging for facilities, tours and motel space; Ms. Fannie Nelson for coordinating registration, setting up information packets, and arranging for the dance band and refreshments; for the support of the state officers, John Alexander (President), Brad Brown (Vice President), Cassandra Minard (Treasurer) and Kimberly Staples (Secretary) and also the associate counselors Ms. Faye Wells and Dr. B. J. Bateman.

We appreciate the continued support of the Senior Academy in AJAS activities and especially the support of Dr. Ken Ottis (President) this year.

- 3) Dr. Ottis then asked for the report of the State Coordinator of Science Fairs. Mrs. Elsie Spencer indicated that since most Fairs had not been held, a complete report was not yet available. She indicated that a report would be submitted at the Fall Executive Meeting.
- 4) Dr. Ottis then asked for the Report of the Gorgas Foundation Coordinator. Dr. Leven Hazlegrove submitted the following:

The Gorgas Scholarship Foundation announced today the rankings of the finalists in the 1982 Alabama Science Talent Search. The search was held at the meeting of the Alabama Academy of Science at the University of Alabama in Birmingham.

The winner of the cash award of \$1600 was Reginald Keith Walton, 7703 Rugby Avenue, Birmingham, AL 35206, from Resource Learning Center, Shades Valley H.S. Annex; Teacher: Sophia Clifford.

Alternates were:

- 1st William Brown Hawkins, Jr., 301 Roxie Drive, Florence, AL 35630, from Bradshaw High School; Teacher: Mary Nell Gonce.
- 2nd Jason Errol Johnston, 2460 Burgundy Drive, Birmingham, AL 35244, from Resource Learning Center, Shades Valley H.S. Annex; Teacher: Sophia Clifford.
- 3rd George Lee McGlamery, 214 Robinhood Drive, Florence, AL 35630, from Bradshaw High School; Teacher: Mary Nell Gonce.

Minutes

- 4th Alasdair Trevoe Downie, 2132 Chickasaw Drive, Florence, AL 35630, from Henry A. Bradshaw High School; Teacher: Mary Nell Gonce.
- 5th Marsha Dawn Worley, 707 Brookside Drive, Opp, AL 36467, from Opp High School; Teacher: Elsie S. Spencer.
- 6th Gary Merle Griner, 411 Zandale Drive, Huntsville, AL 35801, from Huntsville High School; Teacher: Dorothy E. Dale.
- 7th Lisa Ann Armstead, Rt. 3 Box 231, Opp, AL 36467, from Opp High School; Teacher: Elsie S. Spencer.
- 8th Dorinda Jane Simmons, 2808 Womble Street, Florence, AL 35630, from Bradshaw High School; Teacher: Mary Nell Gonce.

The rankings were established by a panel of judges consisting of scientists from many of the leading universities and industries in Alabama.

Winners and alternates in the Gorgas Contest receive offers of tuition scholarships to colleges and universities in Alabama for the study of science. The Gorgas Foundation is named for General William Crawford Gorgas, the Alabama physician who conquered yellow fever in the Panama Canal Zone and later became the Surgeon General of the U.S. Army. The purposes of the Foundation are to promote interest in science and to aid in the education of promising students.

- 5) Dr. Ottis then called for the Report of the Secretary. Dr. John Pritchett, Academy Secretary, summarized the following:

A. Membership

Total Membership (April 1, 1981)	764
New Members (April 2, 1981 - March 16, 1982)	124
Members Deceased	0
Members Resigned	12
Institutional Members Terminated	77*
Total Membership (March 16, 1982)	674
Net Change from April 1, 1982	-13**

* Category of membership removed from By-Laws by action of Executive Committee on April 2, 1981. The remainder will be terminated May 1, 1982.

** This change does not reflect terminated institutional memberships but rather a change in dues-paying individual memberships.

Minutes

Summary of Membership by Section

Section	April 1, 1981	March 16, 1982	Net Change
1	193	182	-11
2	61	61	0
3	28	31	+ 3
4	15	17	+ 2
5	56	62	+ 6
6	38	39	+ 1
7	38	35	- 3
8	41	38	- 3
9	112	112	0
10	46	39	- 7
11	21	27	+ 6
99	30	23	- 7
TOTAL	(679)	(666)	(-13)*
88	85	8	-77

*Reflects individual dues-paying members.

B. Dues Collection for 1982:

Dues Notices (1982) were mailed to all 1981 members with the "Call for Papers" on November 15, 1981. A second reminder was sent out to all 1981 members who had not paid their dues by March 5, 1981. The second reminder was included with the Annual Meeting Program.

<u>Members Subject to 1982 Dues Payment</u>	<u>Total Responses as of March 15, 1982</u>	<u>In Arrears</u>
588	261	327

C. Technical Program for Spring Meeting, 1982

Section	Titles (1981)	Titles (1982)	Net Change
1	49	37	-12
2	24	28	+ 4
3	12	11	- 1
4	14	7	- 7
5	8	22	+14
6	6	20	+14
7	8	7	- 1
8	13	9	- 4
9	47	55	+ 8
10	11	4	- 7
TOTAL	209	211	+ 2

Minutes

- 6) Dr. Ottis then asked for the Report of the Place of Meeting Committee. Dr. Phil Beasley reported that the 1983 Annual Meeting will be hosted by the University of Alabama, Tuscaloosa and the 1984 Annual Meeting will be hosted by the University of South Alabama, Mobile.
- 7) Dr. Ottis then called for the Report of the Resolutions Committee.

Dr. Hoyt Kaylor, Chairman, presented the following resolution:

WHEREAS the Alabama Academy of Science has held its 1982 annual meeting at the University of Alabama in Birmingham, and has enjoyed the hospitality of the University, now therefore

BE IT RESOLVED that the Academy express its gratitude to Dr. S. Richardson Hill, Jr., President of the University, and to the University for hosting this meeting. To Dr. Richard L. Shoemaker, Chairman of our local hosts, and to the members of his host committee; to the Faculty and Staff of the University; and to all of the many others who have contributed to the success of this meeting; we, the Academy members, express our appreciation for their efforts on our behalf.

BE IT FURTHER RESOLVED that the Academy express its appreciation to Dr. Sara C. Finley for her presentation to the Joint Academies.

BE IT FURTHER RESOLVED that the Academy express its appreciation to those who retire from leadership in the Academy this year, and especially to Dr. Kenneth Ottis, our President, and Dr. John Pritchett, our Secretary, who has performed the duties of his office so efficiently and effectively over the last three years.

WHEREAS Dr. Glen Eaves has resigned as Archivist of the Academy due to his forthcoming move to new academic duties in a neighboring state

BE IT RESOLVED that the Academy express its appreciation to Dr. Eaves for the service that he has rendered to the Academy over the years in ordering and preserving the records of the Academy.

WHEREAS Mr. William Hearn, of the School of Agriculture, Forestry, and Biological Sciences of Auburn University has rendered such outstanding efforts to the Academy in the area of computer services for the last six years

BE IT RESOLVED that the entire Academy join the Executive Committee of the Alabama Academy of Science in expressing its gratitude to Mr. Hearn for these services.

It is hereby moved by the Committee on Resolutions that the above be accepted and entered in the Minutes of the Academy.

The motion was seconded and passed unanimously.

Minutes

- 8) Dr. Ottis then asked Dr. Carl Dixon, Chairman of the Research Committee, for his committee report. Dr. Dixon summarized the following:

The Research Committee wishes to submit this report to the Joint Business meeting of the Alabama Academy of Science.

The Committee has selected the four Student Research Awards for papers presented at the Academy meetings on March 18-19, 1982.

1. Phillip E. Morris, Section II, Chemistry, \$50.00
2. Katrina Blackwood, Section IX, Health Sciences, \$50.00
3. Rapheal Luccasen, Section VI, Industry Economics, \$50.00
4. Mark Blackmore, Section I, Biology, \$50.00

The Research Committee has made the following Student Research Grant Awards for 1982-83.

1. Michael H. Irwin, \$250.00. Immunological Ultrastructural Localization of an Acrosin Inhibitor in Ejaculated Mouse Spermatozoa. The check was made out to U.A.B. and sent to Dr. Gary Poirier, the student's research advisor.
2. John L. Hinton, Jr. \$250.00. Isozymic Characterization of the Slipper Lobster, Scyllarides nodifer. The check was made out to the U.A.B. and sent to Dr. George Cline, the student's research advisor.
3. Michael A. Gibson, \$250.00. Paleontology of the Invertebrate Megafauna in the Lagoonal Deposits of the Coal Fields of Northern Alabama. The check was made out to Auburn University and sent to Dr. Robert A. Gastaldo, the student's research advisor.
4. Mary C. Metzger, \$250.00. Zooarcheological Investigation at Tell et - Hayyat. The check was made out to U.A.B. and sent to Dr. Brian C. Hesse, the student's research advisor.

Twelve Travel Awards of \$50.00 each were presented to students who registered and presented papers during the 1982 Alabama Academy of Science meetings in Birmingham, Ala.

Broderick C. Jones, Tuskegee
Kirkley Yearwood, Tuskegee
Wm. R. Gates, Auburn
Larry L. Crowell, Auburn
Helen H. Benford, Auburn
Peter Biersdorfer, Auburn

Janet Legendre, U.S.A.
Rajan Roy, U.S.A.
David Chambers, U.S.A.
Dale Parks, U.S.A.
Wayne Gray, U.S.A.
James Rector, U.S.A.

The travel awards were made out jointly to the student and to the faculty advisor.

Minutes

- 9) Dr. Ottis then asked Dr. Sam Barker for the Report of the Senior Academy Auditing committee. Dr. Barker reported that the accounts and books of the Senior Academy were in good order. He further stated that Dr. James Bradley, Academy Treasurer, was to be commended for the outstanding job he has performed since assuming the position of Treasurer.
- 10) Dr. Ottis then asked Dr. Urban Diener, Chairman of the Nominating Committee, for the report of his committee. Dr. Diener presented the following nominations:

<u>Position</u>	<u>Nominee</u>	<u>Affiliation</u>
President	Charles M. Baugh	University of South Alabama
President-Elect	Raymond Isbell	University of North Alabama
Vice President	John Pritchett	Auburn University
Secretary	Michael Lisano	Auburn University
Coordinator, AAAS	H.A. Henderson	Tennessee Valley Authority
Trustees	Emmett Carmichael	University of Alabama
	William Barrett	Southern Research Institute
	Ed Gentle	South Central Bell
	Jack Moore	University of North Alabama

Dr. Ottis then asked for nominations from the floor. There being none, a motion was made, seconded and passed that the nominations close. Dr. Diener moved that the report of the nominating committee be accepted. The motion was seconded and passed.

(Secretary's Note: The following individuals were elected to Sectional Offices by the individual sections in their business meetings.)

- Section I - Biological Sciences
L. C. Wit, Auburn University
Vice-Chairman (Termination Date, 1983)
- Section II - Chemistry
Thomas Webb, Auburn University
Chairman (Termination Date, 1984);
David Baker, University of Alabama, Tuscaloosa
Vice-Chairman (Termination Date, 1984)
- Section III - Geology
Michael Neilson, University of Alabama, Birmingham
Chairman (Termination Date, 1984)
- Section IV - Forestry, Geography, Conservation and Planning
Steven Sax, Tennessee Valley Authority
Chairman (Termination Date, 1984);
David Weaver, University of Alabama, Tuscaloosa
Vice-Chairman (Termination Date, 1984)

Minutes

- Section V - Physics and Mathematics
Stanley Jones, University of Alabama, Tuscaloosa
Chairman (Termination Date, 1984)
- Section VII - Science Education
Ann Lucas, University of Alabama, Birmingham
Chairwoman (Termination Date, 1984);
Robert Rasheed, University of South Alabama
Vice-Chairman (Termination Date, 1984)
- Section X - Engineering and Computer Science
R. R. Chowdhury, Birmingham
Vice-Chairman (Termination Date, 1983)

Following is a complete listing of all current Academy Officers:

ALABAMA ACADEMY OF SCIENCE

Elected Officers 1982-83

(Affiliation and Tenure Termination Follow Names)

Past President - Ken Ottis, AU, '83
President - Charles Baugh, USA, '83
President-Elect, Ray Isbell, UNA, '83
Vice President - John Pritchett, AU, '83
Secretary - Mike Lisano, AU, '85
Treasurer - Jim Bradley, AU, '84
Editor - Bill Mason, AU, '83
Archivist - Position Vacant

Administrative Officer - William Barrett, SRI, '83

Counselor to AJAS - Eugene O'Masta, TSU, '84
Assoc. Counselor to AJAS - Fay Wells, UNA, '83
Assoc. Counselor to AJAS - B. J. Bateman, TSU, '84
Coordinator of Science Fairs - Elsie Spencer, Opp High School, '83
AAS Counselor - H. A. Henderson, TVA, '85

BOARD OF TRUSTEES

James Sulzby, B'ham, '83
Wilbur Devall, AU, '83
Sam Barker, UAB, '84
Ruben Boozer, JSU, '84
Joe Thomas, UNA, '84
Emmett Carmichael, UAB, '85
Ed Gentle, '85
Jack Moore, '85
Walter Baker, B'ham, '84

Minutes

SECTION CHAIRMAN & VICE CHAIRMAN

- | | |
|---|---|
| I. Biological Sciences
Sam Campbell, UAH, '83
Bob MacGregor, UAB, '83
L. C. Wit, AU, '83 | VI. Industry & Economics
Bill Stewart, UNA, '83
Dean Moberly, AUM, '83 |
| II. Chemistry
Thomas Webb, AU, '84
David Baker, UAT, '84 | VII. Science Education
Ann Lucas, UAB, '84
Robert Rasheed, USA, '84 |
| III. Geology
Michael Neilson, UAB, '84 | VIII. Social Sciences
Hines Hall, AU, '83
John Dunkelburger, AU, '83 |
| IV. Forestry, et al.
Steven Sax, TVA, '84
David Weaver, UAT, '84 | IX. Health Sciences
Walter Wilborn, USA, '83
Ellen Buckner, UAB, '83 |
| V. Physics and Mathematics
Stanley Jones, UAT, '84 | X. Engineering & Computer Sci.
John Cain, AU, '83
R. R. Chowdhury, B'ham, '83 |
| | XI. Anthropology
Brian Hesse, UAB, '83
John Cottier, AU, '83 |

- 11) Dr. Ottis then asked if there were any items of new business. Dr. Sam Barker announced that the Executive Committee had elected Dr. William Barrett to the recently established position of Administrative Officer and stated that the Executive Committee wishes him every success in his new responsibilities.

(Secretary's Note: Since Dr. Barrett has become Administrative Officer, he has chosen to resign his position on the Board of Trustees. Thus a vacancy on the Board now exists. Additionally, Dr. Glen Eaves has recently resigned as Academy Archivist. This position is currently unfilled.)

- 12) There being no further business before the assemblage, Dr. Ottis thanked everyone in attendance for their participation and adjourned the meeting at 2:45 p.m.

Submitted by,

John F. Pritchett,
AAS Secretary

**THE JOURNAL
OF THE
ALABAMA ACADEMY
OF SCIENCE
AFFILIATED WITH THE
AMERICAN ASSOCIATION FOR THE
ADVANCEMENT OF SCIENCE**

VOLUME 53

OCTOBER, 1982

NO. 4

EDITOR:

W. H. Mason, General Biology, Auburn University, AL 36849

ARCHIVIST:

R. G. Eaves, Department of History, Auburn University, AL 36849

EDITORIAL BOARD:

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R. S. Lane, Department of Biochemistry, University of South Alabama, Mobile, AL 36688

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COVER PHOTOGRAPH: Pitcher leaves of the white-topped pitcher plant, *Sarracenia leucophylla* that have been girdled and toppled by feeding of the larva of *Exyra semicrocea*, one of the pitcher plant moths. The larva, protected from above by the toppled portion, feeds and often pupates within the pitcher. Although the damage to the plant seems severe, there is no evidence that the moth harms pitcher plant populations (see article p. 131). Photograph courtesy of Debbie E. Rymal.

LETTERS

A CHANGING FORMAT FOR THE *JOURNAL*

Members and readers will undoubtedly notice that this issue of the *Journal* is quite different from former issues. Our most notable change involves the cover. We plan to use a different cover each time the *Journal* is published.

I will accept for consideration any color photograph, photomicrograph, or electron micrograph that interested persons wish to submit. Candidate material must have been photographed on 35-mm film, developed for slide viewing, and mounted in a 2 x 2 slide holder. It would be best that the subject be oriented parallel to the long axis of the slide. Slides not used will be returned only if a pre-addressed, stamped envelope is provided. A short descriptive paragraph should accompany each submission.

The Letters section is, of course, another new feature of the *Journal*. I encourage any interested reader to submit to the Editor any letter which they desire to have published in this new section. The Editor will select those that are used. The Editorial Board is hopeful that this new medium will promote the kind of lively commentary that will spark interest in both the *Journal* and the Academy.

The Instructions to Authors inside the back cover of each issue states that the *Journal* will consider for publication, "timely review articles of exceptional quality and general readership interest." You will note that such a review article appears in this issue. Persons desiring to prepare a review article might best discuss the

project beforehand with the Editor. The Editorial Board encourages Academy members to consider the preparation of such material.

Future issues are also planned to contain book reviews, especially those having Alabama authors. Anyone desiring to submit a book review should contact the Editor for instructions and suggestions.

Beginning in this issue we will also commence publication of brief memorial articles on past members of the Academy. These preparations should include a 5 x 7 black and white photograph of the deceased. Please submit these directly to the Editor.

In the near future you will note two additional features to be added. One of these will be development of a News section dealing with items of general interest to the Academy membership. The other will involve the inclusion of advertising. Associate Editors will soon be appointed to handle each of these activities.

At this time I feel the need to reassure everyone that the publication of quality research articles remains the *Journal's* primary goal. Such articles will continue to receive two simultaneous peer reviews, and will be published only on the basis of scientific merit. All members of the Academy are encouraged to help our organization grow and develop by using the *Journal* as a means of publishing their research results.

William H. Mason, Editor
101 Cary Hall
Auburn University, AL 36849
Phone (205) 826-5125

READERS RESPONSES TO
PRESIDENT'S MESSAGE

The following is in response to the President's "Message" in the *Journal of the Alabama Academy of Science* (53 (1&2): 1-3).

I will support the Society in whatever decision is made concerning the format of the *Journal*. My personal preference, however, is the combined *Proceedings of the Southeastern Academies of Science* rather than the single large review article format. It seems to me The *ASB Bulletin* has opted for the latter and I find myself thumbing through the long review (entirely out of my area(s) of interest usually) to the news items and then onto the pile on the shelf.

I am certain that at least a few of the Southeastern Societies are experiencing problems similar to ours and would be willing to join together as a group. Hopefully, as anticipated by the AAS, this will generate interest and enthusiasm.

I would also suggest that the Society initiate a campaign for new members. I believe there are many Universities and commercial (military, government, etc.) establishments which are sorely under-represented. Increasing total numbers within the Society will provide both viability and visibility.

I am willing to work with the Society in its efforts to revitalize itself and offer my services. Please feel free to call upon me.

Carol S. Williams
Dept. of Biology
Tuskegee Institute
Tuskegee Institute, AL 36088

I am writing in response to the recent message from the AAS President published in the JAAS. Dr. Baugh offers two suggestions for revitalizing the *Journal*: adoption of a dramatically new format for the existing journal OR merger with other struggling journals of Southeastern Academies of Science. I favor the first suggestion at this time for the following reasons: (1) Enough high quality research is being performed in Alabama to support a quality journal. (2) I know of many scientists who wish to see the tradition of a high quality AAS journal continued, and I believe they will rally to support it with their manuscripts. (3) I have confidence in our new Administrative Officer to initiate a change in the perception which administrators of higher education across the state have of the *Journal*. The *Journal* has nothing to be ashamed of, and should be recognized as the high quality publication which it is. (4) A revitalized journal could not but help the image of higher education in Alabama. (5) A merger with the other Southeastern Academies' journals presupposes their willingness to do so and at best would be a long, arduous process. The rate of manuscript submission would probably slow dramatically during this period as authors anticipated the new expanded journal. Thus, if such a merger attempt were to fail, the attempt itself could cause the demise of our own journal.

Finally, I believe that the Academy Administration should be commended for maintaining a high quality journal during the "hard times" of the recent past. I look forward to the solicitation of short, timely reviews and other new contributions for a journal on the road to recovery.

James T. Bradley
Department of Zoology-Entomology
Auburn University, AL 36849

DEVELOPMENTAL CHANGES IN MYOSIN HEAVY CHAIN mRNA
CONCENTRATION, CYTOPLASMIC DISTRIBUTION AND
UTILIZATION IN EMBRYONIC CHICK MUSCLE CELL CULTURES^{1,2}

Ronald B. Young and Gerald W. Achtymichuk

*Department of Biological Sciences
University of Alabama in Huntsville
Huntsville, AL 35899*

ABSTRACT

Key words: Cell Culture, Myosin mRNA, Posttranscriptional control

Embryonic chick muscle cell cultures were analyzed for polysomal and nonpolysomal myosin heavy chain (MHC) mRNA concentration. Measurements were made during an eight day period so myogenic cells at all developmental stages, ranging from proliferating myogenic cells to mature myotubes, could be evaluated. The number of myotube nuclei and the rate of MHC synthesis were also measured. Thus, as a function of muscle differentiation, we were able to calculate the quantity of nonpolysomal MHC mRNA, the quantity of MHC mRNA actively engaged in MHC synthesis and the rate of MHC mRNA utilization (i.e., molecules MHC synthesized/min/mRNA). Three conclusions were apparent from these experiments: 1) Appearance of MHC mRNA as a ribonucleo-protein particle in the cytoplasm of fusing myoblasts preceded by several hours the active translation of MHC mRNA. Accumulation of polysomal MHC mRNA coincided with an increase in MHC synthesis rate. 2) A significant fraction of MHC mRNA (approximately 30%) continued to be nonpolysomal in fully differentiated muscle cultures exhibiting a maximum MHC synthesis rate of 30,000 MHC/min/nucleus. 3) Enhancement of MHC mRNA utilization apparently occurred after the initial activation of MHC synthesis, since the number of MHC's produced/min/polysomal MHC mRNA increased approximately four-fold between days 2 and 8 in culture.

INTRODUCTION

The possibility that myofibrillar myosin heavy chain (MHC) synthesis is subject to extensive post-transcriptional controls has been controversial in recent years, and the disagreements focus on the following central issue: Prior to activation of myofibrillar MHC synthesis during the early stages of skeletal muscle differentiation,

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does some (or all) of MHC mRNA transiently exist in the form of a non-translated, cytoplasmic messenger ribonucleoprotein (3,4,6,10-12, 18,20)?

The purpose of the present experiments was to evaluate MHC synthesis in muscle cell cultures at all stages of differentiation for the extent of transcriptional and post-transcriptional controls. Specifically, our objectives were: 1) to examine the content and subcellular distribution of MHC mRNA in cultured muscle cells ranging from replicating presumptive myoblasts to fully developed, steady-state myotubes, and 2) to compare the rate of utilization of polyosomal MHC mRNA in muscle cells during their period of rapid myosin accretion immediately after fusion with that in mature myotubes where MHC content and MHC synthesis are at a steady state.

MATERIALS AND METHODS

Materials Avian myeloblastosis virus RNA-dependent DNA polymerase (reverse transcriptase) was a generous gift of Dr. J. Beard of the National Cancer Institute. (^3H)-labeled leucine, dATP and dCTP were obtained from Amersham (Arlington Hts., IL). Aquasol was from New England Nuclear (Boston, MA). Fertile white leghorn eggs were obtained from Reichardt's Hatchery of St. Louis, MI. Acrylamide and N,N'-diallyltartardiamide were from Bio-Rad Laboratories (Richmond, CA). Oligo (dT)-cellulose (type 3) was from Collaborative Research, Inc. (Waltham, MA).

Purification of Myosin Heavy Chain mRNA MHC mRNA was purified from approximately 50 g of 13-day embryonic chick muscle essentially as described by Heywood et al. (10). Poly(A)-containing RNA was purified as described by Aviv and Leder (2), except that Type 3 oligo(dT)-cellulose was used and two complete cycles of binding were carried out. MHC mRNA was subsequently purified by two centrifugations on 10-30% sucrose density gradients containing 1% SDS, 5 mM EDTA and 50 mM Tris-HCl, pH 7.4. Purity of RNA was analyzed by electrophoresis on 1.25% agarose gels containing 2.2 M formaldehyde (14). Cell-free translation of 2-10 μg of MHC mRNA was carried out in a wheat germ assay (8). The mRNA migrated as a single band at 32S, and approximately 90% of the radioactivity incorporated in the cell-free translation assay migrated as a single band with a mol wt of 200,000 during electrophoresis in the presence of SDS.

Preparation and Analysis of MHC Complementary DNA The cDNA preparation procedure was patterned after several studies reporting synthesis of full length reverse transcripts (13,17). The size of MHC mRNA reverse transcripts was estimated from the distribution of radioactivity following centrifugation at 300,000 \times g for 12 hr on 5 ml 10-30% linear sucrose gradients in 0.1 N NaOH and 0.9 M NaCl. Each gradient also contained 50 μg of chick mitochondrial DNA (24 S) so that cDNA size could be calculated (5). The size of (^3H)-labeled MHC cDNA used here ranged from 1,000-5,800 nucleotides. Since MHC

mRNA is approximately 6,500 nucleotides, the cDNA ranged from 15-89%, with an average of 60%.

Muscle Cell Cultures Muscle cell cultures were prepared from the leg muscle of 12-day chick embryos as described by Young et al. (23). Cells were placed in 15 cm diameter collagen-coated polystyrene tissue culture dishes at an initial cell density of 1.38×10^4 cells/cm². Complete culture medium (85% Eagle's Minimum Essential Medium, 10% pre-selected horse serum and 5% chick embryo extract) was replenished daily; plates for all experiments received fresh medium during the 4 hr period immediately preceding sacrifice. Fluorodeoxyuridine (10^{-6} M) was added on day 3 to inhibit overgrowth by fibroblasts. The extent of cellular growth and differentiation was determined in all experiments from Giemsa stained cultures (23).

RNA Extraction from Cell Cultures RNA was extracted from muscle cell cultures after 0.5, 1, 2, 3, 4, 6 and 8 days for analysis of MHC mRNA content. In most instances 12-15 15 cm dishes of 0.5-day and 1-day cells were pooled for each experiment, whereas 3-5 dishes were combined for all other ages. Complete medium was poured from each plate and quickly replaced with approximately 25 ml of ice-cold polysome isolation buffer (0.25 M NaCl, 10 mM MgCl₂, 20 mM Tris·HCl, pH 7.4) to chill the cultures and to rinse out residual culture medium. Cells were scraped from the surface into a minimal amount of polysome isolation buffer containing 0.5% Triton X-100 and lysed as described by Morse et al. (15). The supernatant remaining after centrifugation at 12,000 x g was layered onto 36 ml linear 10-40% sucrose gradients (w/v) in polysome isolation buffer, and gradients were centrifuged at 120,000 x g for 2 hr in a Beckman SW 27 rotor. Polysome distribution in the developed gradients was monitored continuously at 254 nm as described by Young et al. (22) in order to collect nonpolysomal and polysomal fractions. Following collection of polysomal and nonpolysomal material at 105,000 x g for 16 hr, samples were dissolved in 0.5 ml of 50 mM NaCl, 0.1% NaDodSO₄, 6 mM 2-mercaptoethanol, 20 mM Tris·HCl, pH 7.4, and the quantity of ribonucleoprotein was established from absorbance at 260 nm (i.e., by assuming that a solution containing 1 mg ribosomes/ml exhibits an absorbance of 11.2). A quantity of proteinase K (Boehringer Mannheim Biochemicals, Indianapolis, IN) equal to one-tenth the quantity of ribosomal material was added, followed by incubation at 37°C for 2 hr. The digest was extracted once with buffer-saturated phenol, RNA was precipitated two times at -20°C in 67% ethanol, 0.2 M NaOAc, pH 6.0, and dissolved in distilled water. The concentration of RNA was measured by absorbance at 260 nm.

Hybridization Analysis Hybridization reactions were carried out in a final volume of 40 µl containing 0.5 M NaCl, 2 mM EDTA, 10 mM Tris·HCl, pH 7.0, approximately 3,000 cpm of MHC (³H)cDNA and 0.25-50 µg of either nonpolysomal or polysomal RNA. Each hybridization series consisted of six different levels of RNA, with duplicate samples at each level. Controls consisted of samples containing no RNA (to measure the extent of internal hybridization of the (H)

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cDNA) and of samples containing increasing levels of *E. coli* 23 S ribosomal RNA (to measure the extent of nonspecific reassociation of MHC (^3H)cDNA with an RNA species presumably containing no complementary sequences.

Reactions were terminated by placing the tubes in an ice bath. Two aliquots were withdrawn from each hybridization. One was placed in 200 μl of 0.4 M NaCl, 0.2 M NaOAc, 1 mM ZnCl_2 , pH 4.6, followed by the addition of 2 ml of 10% TCA. The second aliquot was placed in the same buffer also containing 0.25 Units/ μl of S^1 nuclease and, after incubation at 37°C for 15 min to digest single stranded regions, 2 ml of 10% TCA was added. Hybrids were collected on Millipore filters (Type HA, 0.45 μm pore size). The percentage of (^3H)cDNA forming stable hybrids was calculated (after subtracting control values) and plotted versus $\log R_t$ (where R_o = RNA concentration in mol nucleotide/L and t = hybridization time in seconds). Reassociation with MHC cDNA occurred with a single transition, and the maximum percentage of reassociation was between 60 and 95%. Double reciprocal plots of these data were employed to unequivocally establish the maximum percentage of reassociation (19).

Measurement of MHC Content and Synthesis Rate The synthesis rate of MHC and the quantity of MHC was assessed from the same culture sample. Triplicate 10 cm culture dishes were pulse labeled with 10 $\mu\text{Ci/ml}$ (^3H)Leu for 4 hr, and myosin-containing material was collected as described by Young et al. (23). Protein samples were electrophoresed on diallyltartardiamide cross-linked polyacrylamide gels, and both the radioactivity and mass of MHC were determined exactly as described by Young et al. (25). Specific radioactivity of (^3H)Leu in the intracellular pool was quantitated by the dual isotope approach of Airhart et al. (1).

RESULTS

MHC mRNA Distribution during Development Initiation of myoblast fusion in chick primary muscle cell cultures varies with initial cell density and culture composition. To evaluate the coordination between initiation of fusion and appearance of MHC mRNA into active polysomal complexes, it was necessary to precisely define the time in cell culture at which fusion and other muscle-specific functions were initiated. Under the conditions employed for this study, the appearance of small myotubes occurred after approximately 24-28 hr. Fusion and accumulation of muscle-specific gene products occurred shortly thereafter (Fig. 1). Especially important for the ensuing experiments are the observations that morphological differentiation was absent prior to 24 hr and that 6-8-day muscle cultures were at a steady-state with respect to MHC concentration (Fig. 1).

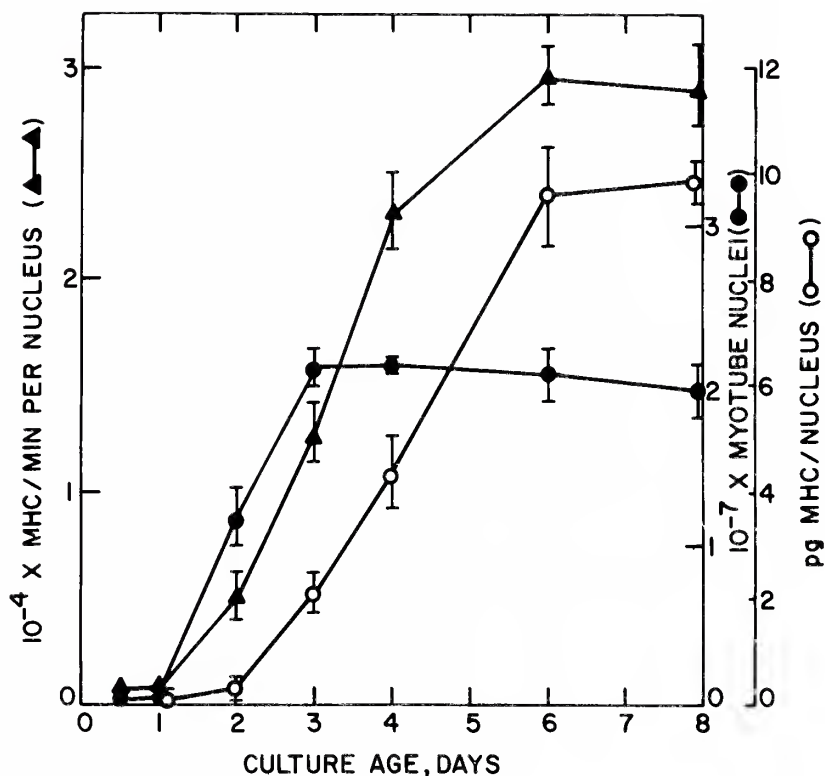


Figure 1. Differentiation pattern of embryonic chick skeletal muscle cell cultures. Myosin heavy chain synthesis rate and content were assessed as described in Materials and Methods. Myotube nuclei were enumerated in 15 cm culture dishes stained with Giemsa. ●, Number of myotube nuclei in each culture dish; ○, pg of myosin heavy chain per myotube nucleus; ▲, MHC synthesis rate in molecules/min/nucleus. Each point represents the mean \pm 1 SEM of five experiments in which all measurements were made in duplicate.

A summary of hybridization analyses for MHC mRNA is shown in Table 1. MHC mRNA was barely detectable in rapidly dividing, 0.5-day muscle cells. After 1 day in culture--before significant levels of fusion were observed (Fig. 1)--mononucleated muscle cells contained approximately 1,200 copies of MHC mRNA; however, approximately 80% of these copies were not associated with polysomes (Fig. 2). By day 2-3 in culture, when MHC synthesis and myotube formation are extensive (Fig. 1), muscle cells exhibited an increase in the total number of MHC mRNA copies. Moreover, the distribution of MHC mRNA reversed

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Table 1. Measurement of myosin heavy chain mRNA transcripts in the nonpolysomal and polysomal fractions of muscle cell cultures between days 0.5 and 8 of development.

Days in Culture	Subcellular Fraction	$R_{0.5} t \ 1/2$	$10^{-3} \times$ Fraction of MHC mRNA Transcripts ²
0.5	Nonpolysomal	660 \pm 142	0.18
0.5	Polysomal	401.7 \pm 35.2	0.30
1	Nonpolysomal	72.1 \pm 14.5	1.68
1	Polysomal	134.0 \pm 15.6	0.90
2	Nonpolysomal	97.1 \pm 17.3	1.25
2	Polysomal	53.8 \pm 7.5	2.25
3	Nonpolysomal	116.5 \pm 27.9	1.04
3	Polysomal	60.7 \pm 13.3	1.99
4	Nonpolysomal	105.6 \pm 20.4	1.15
4	Polysomal	53.5 \pm 18.1	2.26
6	Nonpolysomal	120.4 \pm 30.0	1.00
6	Polysomal	49.4 \pm 7.1	2.61
8	Nonpolysomal	59.6 \pm 7.1	2.03
8	Polysomal	40.0 \pm 2.9	3.02

¹ Each value represents the mean \pm SEM of five experiments in which all measurements were carried out in duplicate.

² Calculated by dividing the $R_{0.5} t \ 1/2$ for MHC mRNA (0.121 ± 0.04) by the $R_{0.5} t \ 1/2$ for nonpolysomal and polysomal RNA.

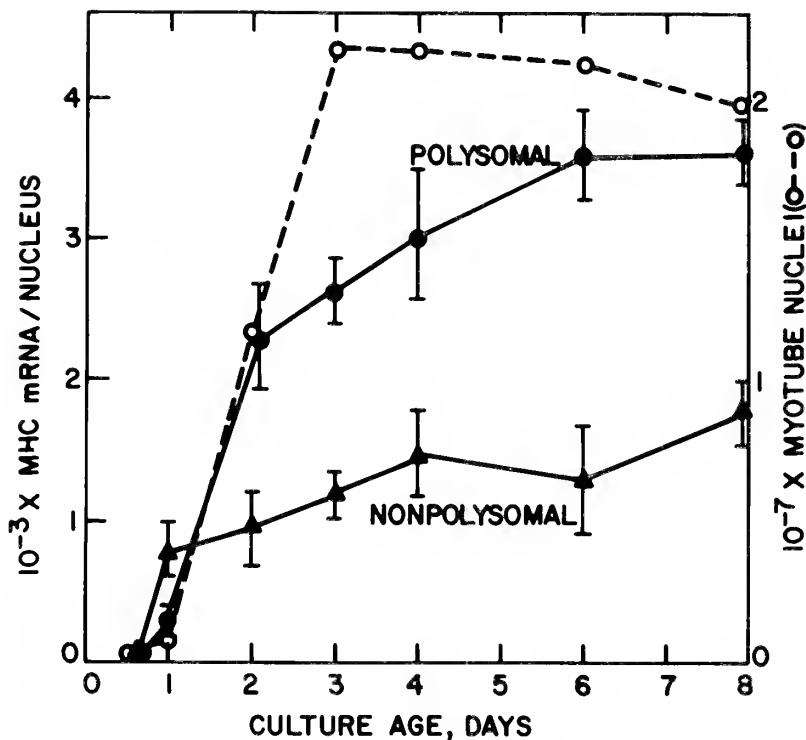


Figure 2. Distribution of MHC mRNA between the polysomal and non-polysomal compartments of developing muscle cells.

so that approximately 75% of MHC mRNA was associated with the polysomal fraction (Fig. 2). As myotubes attained a constant quantity of MHC on day 6-8, the percentage of polysomal MHC mRNA declined to approximately 65%. In quantitative terms, the number of polysomal MHC mRNA copies/cell increased approximately thirty-fold between day 1 and day 6, whereas the quantity of nonpolysomal MHC mRNA copies/cell increased 50% at most (Fig. 2). Steady-state muscle cultures (days 6-8) contained approximately 3,500 and 1,500 MHC mRNA copies per nucleus in the polysomal and nonpolysomal compartments, respectively (Fig. 2).

Changes in MHC Translation Rate During Development In view of the qualitative changes in MHC mRNA distribution in muscle cells during the early stages of differentiation (Fig. 2), we measured whether additional post-transcriptional controls contributed to

regulation of MHC synthesis. Because the number of copies of polysomal MHC mRNA per muscle nucleus (Fig. 2) and the rate of MHC peptide synthesis in molecules MHC/min/nucleus (Fig. 1) were already known, the translation efficiency of MHC mRNA could be calculated in terms of molecules of MHC synthesized/min/MHC mRNA (Fig. 3). The number of peptides synthesized per message copy increased approximately four-fold between days 2 and 8, suggesting that additional translational controls enhance MHC synthesis in post-fusion muscle cells.

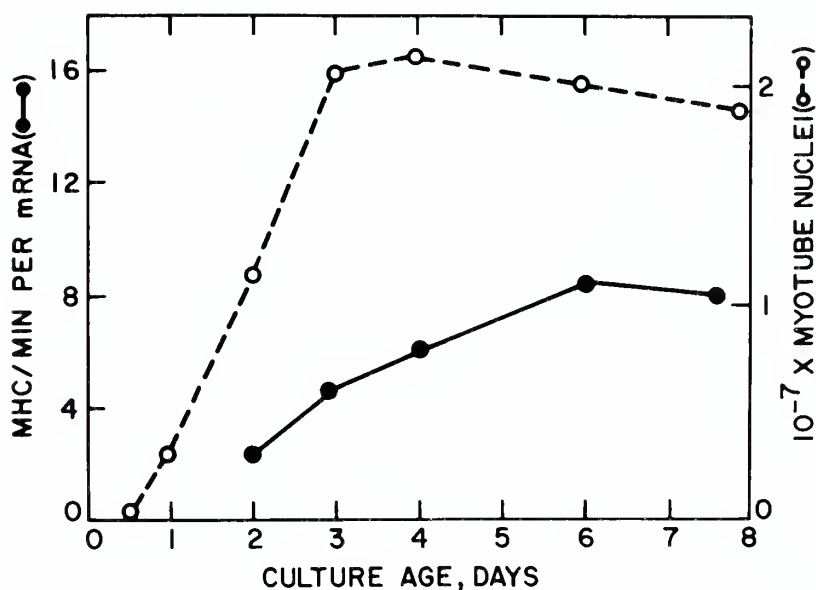


Figure 3. Translational efficiency of polysomal MHC mRNA in muscle cell cultures during development. Changes in the number of myotube nuclei/culture are also shown as a reference to the stage of differentiation. MHC mRNA utilization rate at each age was calculated by dividing the MHC synthesis rate (molecules/min/nucleus) by the MHC mRNA concentration (MHC mRNA/nucleus) to obtain the number of MHC peptides produced by each MHC mRNA per unit of time.

DISCUSSION

Direct evidence that a fraction of MHC mRNA is nonpolysomal in embryonic muscle tissue has been obtained by purification of mRNP particles containing MHC mRNA (3,10,11). Actin mRNA is also present in mRNP particles (3,11). Additionally, the distribution of pulse-labeled MHC and actin mRNA's between the nonpolysomal and polysomal was 35:65, respectively, and remained quite constant between days 11 and 17 of embryonic development. This subcellular distribution of active and inactive MHC mRNA in muscle tissue is consistent with that reported in muscle cell cultures (Figure 3).

While the above research favors the transient existence of MHC mRNA as a non-translated, cytoplasmic ribonucleoprotein particle, several investigations disagree with this conclusion. Analyses of whole cell RNA by cell-free translation experiments indicated that mononucleated myogenic cells contained approximately thirty-fold less MHC mRNA than myotubes (20), but the low level of MHC mRNA was attributed to the small percentage of multinucleated cells that usually contaminate muscle cultures. In apparent agreement with this conclusion, hybridization analyses with (³H)cDNA to MHC mRNA failed to detect a significant quantity of MHC mRNA in mononucleated cultures of chick muscle cells (12) or L₆E₉ myogenic cells (4). Additionally, others have concluded that the cytoplasmic levels of contractile protein mRNA species are predominately responsible for regulating the rate of myofibrillar protein synthesis (6,18).

As in the case with all other studies on primary cultures of chick skeletal muscle cells, the cultures employed for the present experiments contained 15-25% fibroblasts. That these cells do not contribute significantly to the total MHC mRNA pool in differentiating cultures is suggested by the following observations. Muscle cultures at 0.5 days of age (which consist primarily of replicating presumptive myoblasts) contain only 100-200 MHC mRNA transcripts per cell (Fig. 2). Because fibroblast contamination does not change drastically between 0.5 and 1 day in culture, and because 1-day cells already contain approximately 1,200 MHC transcripts per cell (Fig. 2), fibroblasts would cause no more than 10% error even in 1-day cells. This percentage would be lower in older cultures as total MHC mRNA accumulates up to approximately 5,000 copies per nuclear equivalent. It should be pointed out that the MHC mRNA level of 100-200 copies per cell in replicating presumptive myoblasts is likely an underestimate of the true concentration, because of divergence between nonmuscle and myofibrillar MHC sequences (26). Finally, the percentage of fibroblasts remains relatively constant throughout development under these conditions (24), especially after fluorodeoxyuridine is added on day 3.

The translation efficiency of MHC mRNA in 6-8-day muscle cultures (8 MHC/min/mRNA, Fig. 3) is reasonable based on the normal amino acid polymerization rate and the size of MHC. The increase in translation efficiency observed during the later stages of develop-

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ment is less well documented, but has been indirectly inferred by other approaches (16,23). The cellular alterations permitting more efficient utilization of MHC mRNA during this period are unknown.

In view of a recent report (16) that radioactively-labeled MHC mRNA can be inserted into fusing myoblasts and that this mRNA is then actively translated, the presence of significant nonpolysomal MHC mRNA prior to fusion can best be explained as a precursor to polysomal mRNA (7). This explanation also requires that muscle differentiation includes other cytoplasmic alterations that allow nonpolysomal MHC mRNA to be recruited into polysomal complexes shortly after initiation of fusion. The explanation for substantial amounts of nonpolysomal MHC in 8-day, steady-state muscle cultures is less clear, but at least three logical possibilities can be suggested. First, nonpolysomal mRNA could simply be a direct precursor of polysomal MHC mRNA and could be recruited into protein synthesis by the proper intracellular signals (e.g., innervation, intense contraction). Secondly, a fraction of MHC ribonucleoprotein particles might somehow become irreversibly inactivated or partially degraded during transport from the nucleus, thus rendering them incapable of participating in protein synthesis. Alternatively, these inactive species may be the products of normal mRNA degradation. Such species would still be detected by hybridization against (³H)cDNA. Thirdly, the nonpolysomal MHC mRNA species could be an isozyme of the polysomal MHC mRNA species (i.e., they were transcribed from different chromosomal sequences and therefore code for different MHC isozymes). For example, the primary species of MHC found in cultured rat muscle cells in an embryonic form, rather than the adult form (21), and both myofibrillar and constitutive MHC are found within individual myotubes (9). In the third case, unique cytoplasmic conditions would necessarily dictate preferential translation of one species over the other.

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INSECTS ASSOCIATED WITH PITCHER PLANTS
(*SARRACENIA*: SARRACENIACEAE), AND THEIR RELATIONSHIP
TO PITCHER PLANT CONSERVATION: A REVIEW¹

Debbie E. Rymal and George W. Folkerts
Department of Zoology-Entomology
Auburn University
Auburn University, Alabama 36849

ABSTRACT

Insects and other arthropods associated with pitcher plants (*Sarracenia*: Sarraceniaceae) mainly function as prey for the plants, serve as pollinators, inhabit the pitchers, or feed on pitcher plant tissue. Prey scarcity is not a problem in survival of *Sarracenia* populations. Pollinators of pitcher plants are mainly bees, and in the case of the large-flowered species, bumblebees of the genus *Bombus*. At least 16 arthropod species are obligate associates of *Sarracenia*. These include five moths representing four genera in two families, seven flies in five genera and four families, three mites in two genera in two families, and an aphid. A number of other insects and spiders are casual but frequent associates. None of the insect herbivores which feed on pitcher plant tissue represent a threat to *Sarracenia* populations except under very extraordinary conditions. Conservation efforts should be oriented toward conserving this entire spectrum of uniquely associated organisms.

INTRODUCTION

The pitcher plants of the genus *Sarracenia* (Sarraceniaceae) are among the most unique plants in the world. Their unusual insect-trapping leaves and their beauty make them precious biological and esthetic resources. Although taxonomic opinion varies (Bell 1949, McDaniel 1971, Case and Case 1976, Schnell 1977), as many as ten species have been recognized in the genus. The following binomens appear in the recent literature: *S. alabamensis* Case and Case, *S. alata* (Wood) Wood, *S. flava* L., *S. jonesi* Wherry, *S. leucophylla* Raf., *S. minor* Walt., *S. oreophila* (Kearny) Wherry, *S. psittacina* Michx., *S. purpurea* L., and *S. rubra* Walt. Nine of these nominal species range mainly in the southeastern U.S. with one extending west to eastern Texas. The remaining species, *S. purpurea*, also occurs in the southeast but ranges northward to Labrador and Minnesota.

Pitcher plant habitats are being altered and destroyed at an alarming rate (Folkerts 1977, 1982). One species, *S. oreophila*, the green pitcher plant, is federally classified as endangered. A number

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Insects Associated With Pitcher Plants

of other species are categorized as endangered, threatened, or rare in lists prepared in the various states (e.g., Ward 1978, Forsythe and Ezell 1979, Freeman et al. 1980).

Insects and other arthropods associated with pitcher plants interact with the plants in a number of ways. First, insects presumably provide a significant nutrient source for the plants. Second, insects are the pollinators which ensure eventual seed production. Third, a number of insect species have evolved the ability to inhabit the pitchers where they may subsist on pitcher contents for at least a portion of their lives. Fourth, several insect herbivores feed only on *Sarracenia* tissue, and others use it extensively. Additionally, a number of insects and other arthropods are casual or rare associates of *Sarracenia* but are mentioned here because they may be encountered by other workers.

Because of the possibility that insect associates will be of significance in the increasingly intensive efforts to preserve pitcher plant populations, and because some workers have commented on possible co-actions detrimental to the plants (Fish 1976, Troup and McDaniel 1980), we present the following review. Our own information has been accumulated during a number of years of observation and investigation at over one hundred sites, mainly in the southeastern U.S. Our experience in the northern bogs where only *S. purpurea* occurs is limited. We have attempted to include most of the pertinent literature although we do not contend that our list of citations is exhaustive, and we have not included mere locality records, state lists, or general works. Because of the review format of this article, detailed data are not included. It is our intent to aggregate and summarize the available information, provide brief descriptions to facilitate identification and foster understanding of the biological roles of the species, and present our observations and speculations as a basis for thought and further work by others.

A number of workers have presented general information on pitcher plant insects (Riley 1874, Hubbard 1896, Jones 1893, 1904, 1908, 1935). Much of the effort has been concentrated on species associated with *S. purpurea* which, because of its unusual morphology for the genus and the amount of water held in the pitcher, possesses a spectrum of associates rather different from that of the southeastern species. It is also the only species which occurs in the northeastern U.S. where interested entomologists have been numerous.

INSECTS AS PITCHER PLANT PREY

There is little need to dwell on this topic extensively since there is no indication that absence of insect prey has been a factor in the reduction of pitcher plant populations. It is possible that prey insects are scarce at some sites, such as those where *S. oreophila* exists in woodland habitats. However as it relates to survival, prey scarcity would be overshadowed by many other detrimental factors at these sites.

Most pitcher plant species capture a broad spectrum of insect types, but some degree of prey resource partitioning seems to occur (T.C. Gibson, pers. comm., Folkerts 1982). Fish (1976) found that *S. minor* in north-central Florida captures mainly ants. Lists of prey have been provided by a number of workers (Jones 1904, Wray and Brimley 1943, Judd 1959, Swales 1969, 1972).

Other than the occasional entrapped insect which bores through the pitcher wall and escapes, prey insects are entirely beneficial in that they presumably contribute nutrients that would otherwise be limiting or in short supply.

PITCHER PLANT POLLINATORS

Even though the unique flower structure of *Sarracenia* is indicative of a highly evolved mechanism significant in the pollination process, there has been no definitive study of pitcher plant pollination. McFarlane (1908) commented on pollination and Jones (1908) made further comments and provided a list of "habitual visitors" to the flowers of *S. flava*. Schnell (1978), and Folkerts (1982) added comments.

It seems clear that the major pollinators of the large-flowered species (*S. alata*, *S. flava*, *S. leucophylla*, *S. oreophila*, *S. purpurea*) are newly emerged queens of the bumblebee genus *Bombus*. Along the Gulf coast common pollinators are *Bombus bimaculatus* Cresson, *B. fratermus* (F. Smith), and *B. impatiens* Cresson. Farther north *B. pennsylvanicus* (Degeer) becomes more important. Although there is some variation in size, queens of these species are generally too large to enter the flowers of the small-flowered species (*S. minor*, *S. psittacina*, *S. rubra* complex). Worker bees of the aforementioned species are small enough to enter small *Sarracenia* flowers but are not present in numbers until the *Sarracenia* flowering peak is past. Jones (1908) saw small bees of the genera *Augochlora* (Halictidae) and *Osmia* (Melittidae) visiting the flowers of *S. minor*.

A major factor affecting pollination success, especially with bumblebees, is patch size of the plant species. When patch size is small, bees are forced to visit several species in order to secure sufficient pollen and nectar, consequently decreasing pollination efficiency for any species involved (Levin 1978). This may be a factor in the reproductive success of *S. alabamensis*, *S. jonesi*, and *S. oreophila*, forms for which few or no large populations remain. Small patches of *S. flava* and *S. leucophylla* along the Gulf coast, which often represent populations decimated by competition resulting from habitat changes caused by drainage and/or fire suppression, seem seldom to receive much attention from pollinators.

A critical comparative study of pollination processes in *Sarracenia* is needed to determine how they relate to reproductive success and hybridization. We hope to elucidate some of these phenomena in the near future.

PITCHER INHABITANTS

Under this heading we discuss species which typically complete a portion of their life cycle within the pitchers but do not feed on the plant tissue. Although these species have been called inquilines by various authors, this frequently misused term should apply only to organisms which share the homes of other species.

Diptera. Perhaps as many as nine species of flies are obligate inhabitants of *Sarracenia* pitchers. Two of these are associated with only *S. purpurea*. *Wyeomyia smithii* (Coquillett 1901) (Culicidae) (including *W. haynei* Dodge 1947, see Bradshaw and Lounibos 1977), a mosquito, completes its larval development in the fluid in *S. purpurea* pitchers. Most populations of the plant harbor at least a small population of the mosquito. *Wyeomia* larvae feed on micro-organisms and suspended particulate matter in the pitcher fluid (Addicott 1974) and may benefit the plant by conversion of their food into fecal components and nitrogenous metabolites which can be absorbed by the leaf.

Adult *W. smithii* may be seen resting on the plant and flying near it. They do not typically bite humans although exceptions are known (Goins 1977). This mosquito is undoubtedly the most well-studied of the species associated with *Sarracenia* (Coquillett 1901, Dyar 1901, Smith 1902, Mitchell 1905, Dodge 1947, Weathersbee and Arnold 1948, Haufe 1952, Price 1958 a,b, Coyne and Hagman 1964, Wallis and Frempong-Boadu 1967, Barr and Barr 1969, Buffington 1970, Bradshaw 1971, 1976, 1980, Paterson 1971, Smith and Brust 1971, Bradshaw and Lounibos 1972, 1977, Evans and Brust 1972, McIver and Hudson 1972, Hall and Fish 1973, Addicott 1974, Istock et al. 1975, 1976 a,b, Lounibos and Bradshaw 1975, Goins 1977, Fish and Hall 1978, Kingsolver 1979, Bradshaw and Phillips 1980, Moeur and Istock 1980).

Larvae of the midge, *Metriocnemus knabi* Coquillett (Chironomidae) are also obligate inhabitants of *S. purpurea*. In contrast to *Wyeomyia* larvae, the larvae of this species typically occur in the lower portion of the pitcher fluid where they feed on the mass of entrapped prey. Pupae may be found in a gelatinous mass attached to the pitcher wall above the water surface (Coquillett 1904, Knab 1905, Judd 1959, Buffington 1970, Paterson 1971, Dermott and Paterson 1974, Donald and Patterson 1977, Cameron et al. 1977, Fish and Hall 1978).

The remaining fly species, as far as is known, are not specific to any single *Sarracenia* species. Five, and perhaps a sixth species of sarcophagid flies complete larval development by feeding on entrapped prey. Four of these, *Blaesoxipha celerata* (Aldrich), *B. fletcheri* (Aldrich), *B. jonesi* (Aldrich), and *B. rileyi* (Aldrich) form a closely related group comprising the subgenus *Fletcherimyia* (Riley 1873, Aldrich 1916, Jones 1935, Judd 1959, Stone et al. 1965, Forsyth and Robertson 1975, Fish and Hall 1978). Adults of these four species are nearly impossible to differentiate in the field.

Accurate identification can only be accomplished by examination of the male genitalia. All four species occur in several *Sarracenia* species, however only *B. fletcheri* is known from *S. purpurea*. *Sarcophaga sarraceniae* Riley is very similar to the *Blaesoxipha* species and is often found at the same sites (San Jean 1957). Aldrich (1916) reported that a variety of *Sarcophaga utilis* Aldrich also occurs in *Sarracenia* pitchers and conjectured that it might represent a distinct species.

Adult sarcophagids, which grossly resemble oversized house flies, are often abundant in pitcher plant habitats and can frequently be seen resting on the pitchers. Individuals occasionally become entrapped. The large (15 - 20mm), white, conspicuous larvae typically occur singly in pitchers as a result of cannibalism (For-syth and Robertson 1975). They are often quite common, occurring in 64% of the functional pitchers of *S. minor* examined by Fish (1976) in Alachua Co., Florida.

Since sarcophagid larvae consume *Sarracenia* prey, their presence could be considered a detriment to the plant. Fish (1976) thought that larvae in *S. minor*, a species with relatively small pitchers, might consume as much as 50 percent of the prey trapped. However the wastes of the larvae may be available to the plant and larvae killed during aggressive encounters with others may also function as prey at times. Additionally, in *Sarracenia* species with large pitchers, larvae would probably consume comparatively insignificant amounts of prey. At many sites where we have worked in the southeastern U.S., sarcophagid larvae have been very abundant. We saw no indication of damage to plant populations due to their activities.

A sciarid fly, *Bradysia macfarlanei* (Jones), (previously included in *Sciara* and *Neosciara*) is also an obligate associate of *Sarracenia*. This small (3.0 - 3.8mm), delicate, blackish species is found in association with all pitcher plant species except *S. purpurea*. The yellowish larvae have prominent dark head capsules and can be found burrowing among the entrapped prey. Adults can be observed resting on the inner and outer walls of the pitchers. Although the larvae probably consume prey components, their small size and the fact that there are seldom large numbers in a single pitcher indicate that the species is not detrimental to the plants.

The last dipteran which seems to be an obligate associate of *Sarracenia* is a presumably undescribed species of Chloropidae (Folkerts and Rymal, unpublished data) which seems to be restricted to Gulf coast pitcher plant populations, being most numerous in *S. leucophylla*. The adults (2.3 - 3.0mm) in general, resemble a dark *Drosophila* and may be found in numbers resting on the inner walls of pitchers. The small whitish larvae lack a head capsule and burrow through the prey mass. Like *Bradysia*, this species appears to exert no significant detrimental pressure on the plants.

Insects Associated With Pitcher Plants

Jones (1918) reported *Dohrniphora cornuta* (Bigot) (as *D. venusta* Coquillett), a phorid, from the pitchers of *S. flava* in South Carolina. The short, dorsoventrally flattened, brownish-white larvae may be found among the prey, and are present mainly in the late summer after the prey mass has dried. The small (2 - 3mm) dark brownish, humpbacked adults may be seen in the vicinity of the pitchers. This species occurs in many habitats outside of the pitchers and ranges widely in the New World (Stone et al. 1965). We have not found it to be common.

Hymenoptera. None of the wasps which nest in *Sarracenia* pitchers are obligate associates but at least the first species mentioned below seems to prefer to nest in pitchers where they occur within its range, and can be most easily found by searching in this micro-habitat.

The trap-nesting sphecoid wasp, *Isodontia* (*Murrayella*) *mexicana* (Saussure) commonly nests in the leaves of *Sarracenia* species (Rau 1935, Brower and Brower 1970, Fish 1976). Earlier reports of pitcher nesting by *Isodontia philadelphica* (Hubbard 1896, Jones 1904) and *Chlorion harrisi* Fernald (Engelhardt 1928, Rau 1935, Lloyd 1942) also apply to this species (Bohart and Menke 1963). This black slender-waisted species has also been reported to nest in folded yucca leaves, abandoned carpenter bee burrows, hollow stems, bamboo, and sumac twigs (Engelhardt 1928, Rau 1935, Lin 1962, Medler 1965). Trap-nesting wasps have been studied in artificial nesting sites (Krombein 1967) but few natural nests have been found. Pitcher plant nests seem to be ideal for future studies. Jones (1935) felt that this species deserved the common name "sarracenia wasp."

Wasps of this type are called grass-carrying wasps because their nests are built of grass leaves and other fibrous plant materials. In pitchers, a wad of coiled grass plugs the bottom of the tube, above which is a bed of loosely compacted grass on which are placed the prey insects. The eggs are deposited at this site and the larvae hatch and feed on the paralyzed prey. A bit of loose grass and a tighter plug of coiled grass are placed over the brood chamber. Occasionally a tuft of grass can be seen protruding from the pitcher orifice. Solitary nests, unicellular multilarval chambers, and multicellular unilarval chambers partitioned by sections of dry grass have been observed in pitchers. The latter two types have previously been reported for this species (Bohart and Menke 1976).

Isodontia mexicana preys primarily on gryllid and tettigoniid orthopterans. At a single locality all captures seem to be of a single species. In pitcher plant bogs, Rau (1935) and our study found the common prey to be nymphs of the tettigoniid genus *Conocephalus*, often *C. fasciatus* (DeGeer). In the Southeast, pitcher nests are heavily preyed upon by the red imported fire ant, *Solenopsis invicta* Buren, which consumes the larvae or pupae and the prey.

Construction of a nest within a pitcher prevents further insect capture. The female wasp may actually clean the site of previously trapped prey before preparing the nest. Fish (1976) reported its presence in 2.5 percent of the functional leaves of *S. minor* at a site in Alachua Co., Florida. Concentrations higher than this were never observed during our study. Thus, although individual leaves may be rendered functionless, this insect presents no threat to the health of pitcher plant populations.

Two less frequent types of wasps nests have been observed in pitcher plant leaves. Bernon (1969) found an active nest of the vespid paper wasp *Polistes fuscatus pallipes* Lepeletier in a pitcher of *S. purpurea* in Massachusetts. In a few Gulf coast bogs, dirt-filled pitchers of *S. rubra* and *S. alata* have been noted. Some contained paralyzed salticid and clubionid spiders with small hymenopteran larvae attached. Although adult wasps were never obtained for identification, these were probably nests of another sphecid. Some species are known to prey on spiders and place several prey items in a single nest (Bohart and Menke 1976).

Acarina. We include mites because workers interested in pitcher plant insects will also encounter these arthropods. Three species are known to be specific to *Sarracenia* pitchers and others may occasionally occur.

Two of the mites are anoetids which scavenge on the remains of decomposing prey or on microorganisms associated with prey decomposition. *Anoetus gibsoni* (Nesbitt), originally described as *Zwickia gibsoni* (Nesbitt 1954, Hughes and Jackson 1958), inhabits only *S. purpurea* where it occurs on the pitcher walls beneath the surface of the liquid. *Anoetus hughesi* Hunter and Hunter has been reported from *S. flava* and *S. minor* (Hunter and Hunter 1964) and seems to occur in all species except *S. purpurea*. Individuals may be found among the mass of entrapped prey or on the pitcher walls above the prey mass. Both of the *Anoetus* species are medium-sized (adults .3 - .5mm) light-colored mites in which the adults appear hairy because of their long setae.

Macroseius biscutatus Chant, Denmark, and Baker, is a phytoseiid mite which occurs abundantly in the pitchers of various *Sarracenia* species in the Southeast. It is conspicuously larger than the *Anoetus* species (adults .55 - .60mm). Although most phytoseiids are predaceous, Chant et al. (1959) reported that specimens of *M. biscutatus* were found associated with frass of species of the noctuid moth genus *Exyra* (see later section). We have found specimens in pitchers which contained no frass. The trophic relationships of *Macroseius* therefore remain unclear.

Judd (1959) and Swales (1969) reported mites of the genus *Histiostoma* (Anoetidae) in the leaves of *S. purpurea*. Species of this genus occur widely in decaying organic matter (Krantz 1978). None are specific to *Sarracenia*. Swales (1972) later stated that the specimens reported as *Histiostoma* may have been *Anoetus gibsoni*.

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The mechanisms of dispersal of these mites are not definitely known. Hunter and Hunter (1964) hypothesized that *Anoetus* individuals were phoretic on insects. If this is the case they may use *Exyra* moths since no other insects are common to the habitats of both species. Insects which are attracted to nectar at the pitcher orifice may be used but the dispersal stage (hypopus) would have to lie in wait in this area of the pitcher. Hunter and Hunter (1964) reported that the hypopial stages of *Anoetus hughesi* occurred on the wall above the insect remains but did not mention their presence near the pitcher orifice. None of the mites mentioned seem to be detrimental to the plants.

PITCHER PLANT HERBIVORES

At least five insect species feed only on pitcher plant tissue. Typically it is the pitcher tissue that is attacked although one insect species occurs only in the flowers.

The insect herbivores which feed on *Sarracenia* seem to be less diverse and of fewer species than the spectrum of insect herbivores occurring on a number of other bog species. For instance, no chrysomelid, scarabaeid, or curculionid beetles feed on *Sarracenia*. Pentatomid or cicadellid bugs are almost never encountered. The lepidopteran larvae which feed on *Sarracenia* include members of only four genera in two families. These facts suggest that pitcher plants may have evolved some chemical defenses against insect herbivores. Cattle do not graze on *Sarracenia* leaves (Plummer 1963, Folkerts 1978, 1982) and we have observed that hogs leave them untouched. Low nutrient quantity and quality characterize some plants that have few insect herbivores, but ungulates seldom avoid such plants. It is not known if the tannin content of *Sarracenia* leaves is high, but they do seem to be more highly lignified than the leaves of most other species in their habitat.

Homoptera. The aphid *Macrosiphum jeanae* Robinson often occurs in large numbers in the second-year pitchers of *Sarracenia purpurea*. This green, clear-winged species has been reported only from Canada (Robinson 1972), and therefore presumably only occurs on *S. purpurea*. Its entire life history occurs on the plant. We do not have the experience to accurately assess the damage done by this species, but because it only occurs in second-year pitchers whose entrapment function may have already been lost or reduced in efficiency, the damage is probably negligible.

Lepidoptera. The larvae of several moth species feed on pitcher plant tissue. Most intimately associated with *Sarracenia* are the species of the noctuid genus *Exyra* Grote, all of which are obligate inhabitants of pitcher plants. All stages of the life cycle occur within the pitchers. Although they possess no immediately obvious structural adaptations, they appear to be the only insects which can successfully locomote on the downward pointing hairs which cover the inner surface of the pitchers. Four nominal species are assigned to

the genus: *E. semicrocea* (Geunee), *E. ridingsii* (Riley), *E. rolandiana* Grote, and *E. fax* (Grote) (Grote 1879). Only three of these names are generally considered valid, the epithet *fax* not typically being used. Their validity and nomenclatural history is currently being investigated (Rymal, in manuscript.)

Exyra semicrocea was reported from five *Sarracenia* species by Jones (1921). We have found it in all ten nominal species during this study, most abundantly in *S. leucophylla* along the Gulf coast and in *S. alata* in Texas. Adult *E. semicrocea* average 11 mm in length, although size varies considerably, probably reflecting larval nutrition and pitcher size. The basal ivory colored portion of the forewings are clearly demarcated from the black distal half. The hind wings are black or grey. The filiform antennae are yellow. The head and prothorax are black and the rest of the body and legs are ivory. An entirely ivory form and a mottled form are occasionally encountered and have been called *E. semicrocea* var. *immaculata* Benjamin and *E. semicrocea* var. *hubbardiana* Dyar, respectively (Kimball 1965).

The bright coloration of *E. semicrocea* larvae is unusual for a noctuid. Larvae are banded with red and white and have four conspicuous pairs of lateral projections, the lappets. The pattern and color is cryptic on the white, red-veined upper portion of the *S. leucophylla* leaf.

Exyra ridingsii seems to be the least abundant species and is known only from *S. flava*. Adults are somewhat larger than those of *E. semicrocea*. The forewings are patterned throughout with black bands alternating with ivory, the bands becoming broader toward the outer edge of the wing. Irregular black markings occur on the legs. The larvae are banded but the bands are duller than in *E. semicrocea* and the lappets are less pronounced than those of the latter species.

Exyra rolandiana has been reported to be specifically associated with *S. purpurea* (Jones 1921), although adults were found in pitchers of *S. flava* by Jones (1904), and during the present study. As far as is known, the life cycle can only be completed in *S. purpurea*.

Adult *E. rolandiana* differ conspicuously in coloration from adults of the other two species, and considerable variation occurs. The forewings vary from maroon with black and ivory blotches to irregularly banded with black and ivory, and at times are entirely black. The body and wings are covered with an intermixture of ivory and grey scales. The larvae are not as brightly colored as those of *E. semicrocea* and lappets are lacking.

Aspects of the biology of *Exyra* species have been treated in a number of works (Riley 1874, Jones 1893, 1904, 1907, 1908, 1921, Hubbard 1896, Judd 1957, Brower and Brower 1970, Fish 1976, Rymal 1980). Along the Gulf coast *E. semicrocea* exhibits four overlapping generations per year and overwinters as a late instar larva (Rymal

1980). Pupation begins in early spring and adults emerge coincident with the maturation of the first pitcher plant leaves. From one to several eggs are laid singly on the inside wall of a pitcher. Newly hatched larvae typically girdle the pitcher with a narrow feeding channel, causing the upper portion to wilt and topple, thereby effectively closing the pitcher opening. Larvae usually occur singly in leaves and feed only on the inner portion, leaving the outer epidermis intact. Three or four leaves are partially consumed during the five larval stadia (Rymal 1980). Feeding larvae are nearly always enclosed in a protective chamber consisting of a ceiling of silken webbing or toppled leaf tissue above and protected below by their frass deposits. Pupation generally takes place in an undamaged pitcher. The orifice is typically closed by a sheet of webbing. Prior to pupation the larva cuts a tiny drainage hole just below the position in which the larva will attach itself to the wall by webbing.

Adults rarely stray from their resting sites within pitchers. Most flight takes place at dusk when females fly to new pitchers and males search for females. Copulation occurs within pitchers with the copulating pair positioned at right angles so that both face partially upward (Rymal 1980).

The life histories of the other two *Exyra* species are quite similar, differing from that of *E. semicrocea* in features that adapt them to their specific host plants. *E. ridingsii* pupates and hibernates in a chamber of larval frass. Newly hatched larvae remain for several days, covered by silk and frass, in the groove in the throat of *S. flava*, where the eggs are laid. *Exyra rolandiana* larvae consistently use webbed orifices and drainage holes, a necessary adaptation because the pitchers of *S. purpurea* are open to rain and usually hold considerable quantities of water.

The damage that *Exyra* larvae cause to *Sarracenia* leaves is conspicuous and can be alarming. However, they rarely consume an entire leaf and seldom are all of the leaves on a plant attacked. Partially consumed leaves, although the orifice may be blocked, can probably continue photosynthesis and absorption of nutrients from prey. The larval wastes, which are deposited in the pitchers, may return some nutrients to the plant if components can be absorbed. Cellulose degrading fungi, which are known to grow on insect feces (Schreiber and Mason 1976), may play a part in liberating substances that can be absorbed by the pitchers.

We have found *Exyra* species present at nearly every pitcher plant site we have visited. At a few sites virtually every leaf showed some signs of *Exyra* damage. Some populations of *Sarracenia* in large, undisturbed bogs have sustained large *Exyra* populations without apparent long term damage. Natural control of *Exyra* populations occurs as a result of the actions of avian and spider predators, dipteran and hymenopteran parasites, and fungal, bacterial, and viral pathogens. In our opinion, these moth species do not present a

significant danger to the continued existence of pitcher plant populations.

The "Sarracenia root borer", *Papaipema appassionate* Harvey, is another noctuid moth whose larvae feed only on pitcher plant tissue. The large larvae feed by burrowing in the underground rhizomes. Their presence can often be detected by the turret of frass left at the opening of their burrows. Mature larvae are reddish brown with longitudinal white stripes and reach a length of 3 - 4 cm. Their burrows can be extensive enough to cause entire clumps of pitcher plants to wilt and die. Adults average 3.8 mm in wingspan. They are yellow with maroon flecks and have two groups of small white dots at the center of each forewing.

Although *P. appassionate* is potentially very damaging to pitcher plant populations, it is relatively rare. Bird (1903) reported it from *S. purpurea* in New Jersey, and Jones (1908) found it attacking *S. flava* in South Carolina. It has also been collected in New York, Quebec, Ontario (Forbes 1954) and Maine (Brower and Brower 1970). We have not found it in the southeastern U.S. during this study.

The larvae of two tortricid moths feed on the flowers and developing fruits of *Sarracenia*. One of these species, *Endothenia daeckiana* (Kearfott) (formerly *Olethreutes daeckiana*, at times placed in the family Olethreutidae) seems to be restricted to *S. purpurea*. The larvae bore into the ovary base and consume seeds within. Pupation occurs within the flower stalk down which the larva bores when mature. Adults emerge in the spring after the pupae push through the epidermis which covers a pre-chewed exit hole made by the larva (Hilton 1982). Adults are small (15 - 18 mm wingspan) and of a mottled grayish-brown color. Hilton (1982) found as high as 71 percent infested stalks at some sites and found other sites where the moth was absent. He also found that one or more carpels of the flower usually remain uninfested, so presumably this species never completely prevents seed production.

Jones (1908) reported the aforementioned species from *S. minor* in South Carolina. However, because the life history traits of the moth he described vary considerably from the habits of *E. daeckiana* as described by Hilton (1982) we believe it to be a different species. Even though Kearfott identified the Jones material, he may have based his identification mainly on the fact that the specimens came from *Sarracenia*. It is possible that this species is *Endothenia hebesana* Walker, a species which feeds on a variety of hosts, and reported from pitcher plants by Forbes (1923). However, it may be undescribed or may represent a different species. The greenish white larvae of the species we encountered feed on the flower parts and bore into the developing fruit and feed on the seeds and tissue within. Their presence can be detected by frass and debris which are fastened by silk to the wilting perianth parts. Pupation takes place in the partially consumed ovary. The adult is

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small (15.0 mm wingspread in one specimen we measured) and of a light brown mottled color. We have found this form in *S. leucophylla* and *S. rubra*.

Troup and McDaniel (1980) mentioned what was probably this species as a factor in curtailing seed production in *S. oreophila* populations. In our experience, however, the larva rarely destroys more than half of the fruit, which generally produces a quantity of seeds in excess of that needed for population continuance.

Another tortricid, *Choristoneura parallela* (Robinson) (called *Archips parallela* and *Cacoecia parallela* in some works), feeds at times on pitcher plant tissue, although it also occurs on many other hosts (Freeman 1958). Jones (1908) found it feeding on small leaves of *S. minor* in South Carolina. The larva, which has been described by MacKay (1962), spins an extensive web of silk within the pitcher tube, feeds on the leaf tissue, and pupates in the angle formed by the wing of the pitcher and the outer surface of the tube. We have found a tortricid with similar habits feeding on *S. leucophylla* and *S. rubra* in southern Alabama. Adults were not obtained for positive identification. Because this species is only occasionally encountered it cannot be considered a threat to the survival of *Sarracenia* populations.

RARE AND CASUAL ASSOCIATES

In addition to the obligate associates and the frequently encountered more generalized associates mentioned earlier, many arthropods are occasionally associated with pitcher plants in less obvious ways. Additionally, a few rare species exist whose relationships to pitcher plants are yet to be determined.

A number of polyphagous insect herbivores occasionally feed on *Sarracenia* tissue. Grasshopper damage to the pitchers can often be seen but is never extensive enough to warrant concern. Thrips, probably of a number of species, are frequently seen on pitchers, but the damage they cause is very minor. Leaf cutter bees cut round sections from the petals when plants are in flower, and occasionally use old pitchers as nesting sites, but probably harm the plant little. Some leaf cutter species may be pollinators.

We found a scale insect of the genus *Aspidiotus* (Diaspididae) on a pitcher of *S. psittacina* in southern Alabama. It probably represents an undescribed species (Michael L. Williams, pers. comm.). Whether or not it is specific to *Sarracenia* cannot be determined without further investigation.

The fluid in *Sarracenia purpurea* sometimes harbors organisms that typically occur in aquatic environments outside pitchers. Brower and Brower (1970) reported the larva of a caddisfly, *Frenesia difficilis* Walker (Limnephilidae), and a freshwater isopod *Asellus*

communis Say from fluid in *S. purpurea* pitchers. Mather (1981) collected two alderfly larvae, *Sialis joppa*, Ross in separate pitchers of *S. purpurea* at a site in New Jersey. We have found both isopods and amphipods in *S. purpurea* pitchers in southern Mississippi but attribute their presence to prior flooding of the site which had completely inundated the pitchers and diluted the fluid within.

Spiders are abundant in pitcher plant habitats and are associated with the plants as prey (Wray and Brimley 1943) and as predators on insects attracted to the pitchers. Although no spider species are known to be restricted to pitcher plant bogs, several are commonly encountered in bogs throughout the Southeast. Hubbard (1896) mentioned that a spider of the genus *Lycosa* (Lycosidae) used pitcher plants as a site to capture prey and as a retreat for rearing young. The species that we have commonly encountered use a variety of behavioral adaptations in exploiting the pitcher plants attractiveness to their insect prey.

Peucetia viridans (Hentz) (Oxyopidae), the green lynx spider, is common in many habitats and occurs abundantly in pitcher plant bogs. These large cryptic hunting spiders rest on the hoods of pitchers and overcome attracted insects. Although silk is not used in prey entrapment, a small amount of webbing is nearly always present in the form of a dragline network which keeps the spider from being trapped in the pitcher. In the fall, females suspend egg cases by silk just inside the pitcher tubes. Eggs and young are guarded by the female.

Phidippus rimator (Walckenaer) (Salticidae) is another common spider which is abundant in southeastern pitcher plant bogs. These bright red jumping spiders move swiftly about on the pitcher exteriors and leap on prey from considerable distances. They do not normally enter the pitchers, but since they rarely spin a drag line they are occasionally entrapped. Like *Peucetia*, however, they do use pitcher chambers, especially older ones which have lost some of their trapping function, as sites for rearing young. Egg cases and young spiderlings are contained within a thick mass of cotton-like silk attached to the pitcher walls. A similar site is occupied by overwintering adults.

Strotarchus piscatoria (Hentz) (Clubionidae) is a ubiquitous species in southeastern bogs. These brownish spiders with large dark chelicerae attack insects from a thin, silken, sac-like retreat attached to the wall within the pitchers. Young are reared within the sac. This species was found to prey heavily on overwintering larvae of *Exyra semicrocea* in southern Alabama (Rymal 1980).

Another spider which often uses pitcher interiors as resting sites is *Tibellus duttoni* (Hentz) (Philodromidae). These long-bodied spiders rest with the four front legs extended anteriorly and the four hind ones extended posteriorly, making them difficult to see in the pitchers.

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The "flower spiders" (*Misumena*, *Misumenops*, *Misumenoides*, Thomisidae) can slowly change color to match their surroundings. Several species are commonly found on flowers and pitchers.

Pitchers of *S. leucophylla* were found incorporated into the webs of a population of funnel weavers, *Agelenopsis* sp. (Agelenidae). The platform portions of webs were suspended between pitchers and the funnel portions extended into the pitcher tubes.

Spiders of the genus *Dolomedes* (Pisauridae), the fishing spiders, are common in wetlands and may sometimes be found on the surface of the fluid in *S. purpurea* pitchers.

CONCLUSIONS

Most of the arthropod species associated with pitcher plants cause no significant harm to the plants under any conditions. In exceptional cases, certain species, e.g. *Papaipema appassionate*, and the *Endothenia* species may apparently cause extensive damage. In our opinion, the low frequency of occurrence of these types at most sites precludes their being a source of major concern. Totally, at least in our experience, there are no reasons to contemplate control of any of these species in concert with efforts to preserve pitcher plant populations.

At least 16 of the species associated with *Sarracenia* seem to be completely dependent on the plants for their existence. These forms enhance the uniqueness of the pitcher plant ecosystem and are as worthy of preservation as the pitcher plants themselves. We suggest that all species in the ecosystem should be considered valuable in our efforts to preserve the integrity of sites harboring pitcher plants.

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MEMORIAL



Reynolds Q. Shotts
(1909-1982)

Reynolds Q. Shotts was born in Double Springs, Alabama on February 1, 1909 and died in Druid City Hospital in Tuscaloosa, Alabama on July 18, 1982 after a lengthy illness. He is survived by his wife, Ruth; his daughters, Mrs. Hugh Edmonds of Centreville, Alabama; Ms. Eleanor Shotts, Birmingham, Alabama; and two grandsons, Rick and Steve Edmonds, both of Centreville.

He received a B.S. degree in Mining Engineering in 1930 and an M.S. degree in Mining Engineering in 1931, both from The University of Alabama. Graduating during the depression years from 1931 to 1936, Rey found work teaching high school mathematics and science and performing professional services for TVA as a geologist in 1933-34. His introduction to teaching began when he accepted a position as

professor at Rabun Gap, Georgia, in 1936. He was made assistant dean and registrar in 1937 and stayed there until 1941. In the fall of 1941, he accepted a position at The Citadel as professor of chemistry and mathematics and stayed there until 1942. In the summer of 1942, he accepted an assignment with the Letroneau Company of Georgia in Toccoa as metallurgist. He stayed there for one year, and in the fall was offered a job as assistant fuels technologist at his alma mater and served in this capacity from 1943-46 when he was made assistant professor. It was during these years that he started on the road to becoming an expert on Alabama coal deposits. When the mining department at The University of Alabama was designated as the State Mine Experiment Station under the School of Mines, Rey wrote profusely about the quality of Alabama coals, publishing a number of technical reports on Alabama coal. In 1947, he was made associate professor and in 1951 was promoted to professor, a position he held until his retirement on June 30, 1979, serving for 35 years.

Rey's greatest attribute was his memory; he had a flair for remembering faces and names of students he taught from years past. He would recognize former students of 15-20 years, even though the occasion was a chance meeting underground and the student was garbed in miner's clothes, his face blackened with coal dust, and the lighting poor. He kept an unofficial record and file of former students in his office and this file remains as one of the most usable and accurate sources on former students of the department.

He was a walking history book of people, places, and events in Alabama and the neighboring states. Taking trips with Rey around the state brought a detailed story about a place and event that occurred 25 or 30 years ago. He would provide information on the name of the underlying coal seams in an area, giving the acreage, tonnage, overburden, area of outcrop, and the quality of the coal, as well as who had mined it, when it was mined, and when mining ceased. He was also well known for his daily puns both in and out of the classroom. Each month as statistical data on coal production in the United States was received, Rey would hasten to show Alabama's status in tonnage and rank and why this was so. It is not widely known, but Rey was one of the United States' few foremost experts on lunar mining, a distinction he gained while performing research under a NASA contract in the 1960's.

Rey Shotts loved his fellow man and was unselfish in his devotion to his church, Trinity Methodist of Tuscaloosa, and all the activities associated with it. Rey felt no ill will to anyone of anything. Rarely did he raise his voice in anger; it took an awful lot to provoke him. He was devoted to his family, church, work, students, and the University, and his efforts in this regard were relentless and unceasing.

Reynolds Q. Shotts

Rey leaves many friends who remember him as a true Christian gentleman, respected and admired by all who knew him. His willingness to talk and jocular mannerisms at faculty gatherings will be missed. I am particularly proud for having had Rey as a friend and colleague and it is comforting to know that many others feel the same.

He was an active member of the Society of Mining Engineers of AIME, Fellow of the Alabama Academy of Arts and Sciences, American Society of Engineering Education, Alabama Academy of Science, Society of Sigma Xi, Tau Beta Pi, and Pi Mu Epsilon. Rey did a lot of coal consulting work for private individuals, companies, and government agencies because of his extensive and profound knowledge about coal deposits in Alabama and neighboring states.

Prepared by:
Thomas A. Simpson
Associate Professor
Department of Mineral Engineering
The University of Alabama

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